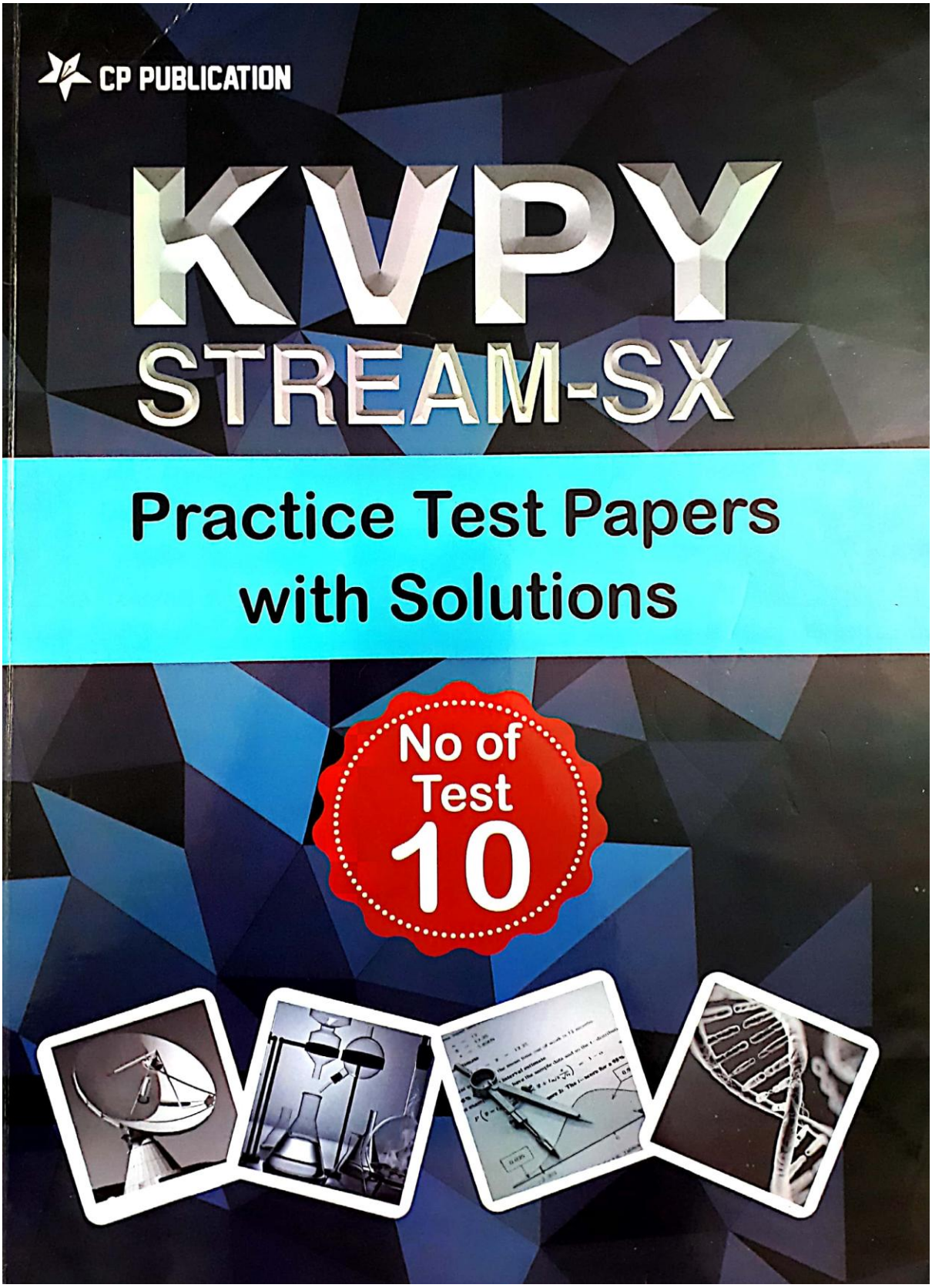

CP PUBLICATION
KVPY
STREAM-SX
Practice Test Papers
with Solutions
No of
Test
10

CONTENTS

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-1

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 If $A(n)$ represents the area bounded by the curve $y = n.\ell nx$, where $n \in N$ and $n > 1$, the x-axis and the lines $x = 1$ and $x = e$, then the value of $A(n) + nA(n-1)$ is equal to -

(A) $\frac{n^2}{e+1}$ (B) $\frac{n^2}{e-1}$ (C) n^2 (D) en^2

Q.2 If $\sqrt{1-x} > \sqrt{1+x}$, then the complete solution set of x is -

(A) $(-\infty, 0)$ (B) $[-1, 1]$

(C) $(0, 1]$ (D) $[-1, 0)$

Q.3 If ${}^mC_3 + {}^mC_4 > {}^{m+1}C_3$, then the least value of m is -

(A) 6 (B) 7

(C) 5 (D) none of these

Q.4 $\sqrt{-2+2\sqrt{-2+2\sqrt{-2+....\infty}}}$ is equal to -

(A) $1 \pm i$ (B) $-1 \pm i$

(C) ω or ω^2 (D) $-\omega$ or $-\omega^2$

Q.5 If $f(x) = \max\{\sin x, \sin^{-1}(\cos x)\}$, then -

(A) f is differentiable everywhere

(B) f is continuous everywhere but not differentiable

(C) f is discontinuous at $x = \frac{n\pi}{2}$, $n \in I$

(D) none of these

Q.6 $\int_{-1}^{1} \frac{x^3+|x|+1}{x^2+2|x|+1}\,dx = 2\,\ell n\,2 + b$ then -

(A) $a = 2;\ b = 1$ (B) $a = 2;\ b = 0$
(C) $a = 3;\ b = -2$ (D) $a = 4;\ b = -1$

Q.7 If the system of equations $bx + ay = c$, $cx + az = b$, $cy + bz = a$ has unique solution, then -

(A) $abc = 1$ (B) $abc + 2 = 0$
(C) $abc \neq 0$ (D) $abc + 1 = 0$

Q.8 If $f(x) = (ax^2 + b)^3$ then a function $g(x)$ such that $f(g(x)) = g(f(x))$ is given by -

(A) $g(x) = \left(\frac{b - x^{1/3}}{a}\right)^{1/2}$

(B) $g(x) = \frac{1}{(ax^2+b)^3}$

(C) $g(x) = (ax^2 + b)^{1/3}$

(D) $g(x) = \left(\frac{x^{1/3} - b}{a}\right)^{1/2}$

Q.9 If $P(x_1, y_1)$, $Q(x_2, y_2)$, $R(x_3, y_3)$ and $S(x_4, y_4)$ are four cyclic points on a rectangular hyperbola $xy = c^2$ the coordinate of the orthocenter of the ΔPQR are -

(A) $(x_4, -y_4)$ (B) (x_4, y_4)
(C) $(-x_4, -y_4)$ (D) $(-x_4, y_4)$

Q.10 $\int \frac{dx}{x^2(x^5+1)^{4/5}}$ equals -

(A) $c + \frac{\sqrt[5]{1+x^5}}{4x}$ (B) $c - \frac{\sqrt[5]{1+x^5}}{x}$
(C) $c - \frac{\sqrt[5]{1+x^5}}{5x}$ (D) $c + \frac{\sqrt[5]{1+x^5}}{x}$

Q.11 If $\lim_{x\to 0} \frac{729^x - 243^x - 81^x + 9^x + 3^x - 1}{x^3}$
$= K(\ell n 3)^3$ then K is equal to -

(A) 4 (B) 5 (C) 6 (D) 8

Q.12 The value of x in the interval $[0, 2\pi)$, where $f(x) = e^x \cdot \sin x$ has maximum slope is -

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$ (C) π (D) $\frac{3\pi}{2}$

Q.13 If g is the inverse of f & $f'(x) = \frac{1}{1+x^5}$ then $g'(x) =$

(A) $1 + [g(x)]^5$ (B) $\frac{1}{1+[g(x)]^5}$

(C) $-\frac{1}{1+[g(x)]^5}$ (D) none of these

Q.14 If $f(x)$ is a monotonically decreasing function and have concavity up then its inverse $f^{-1}(x)$ will be -

(A) decreasing and have concavity upwards
(B) decreasing and have concavity downwards
(C) increasing and have concavity downwards
(D) increasing and have concavity upwards

Q.15 Sum of all the digits used in writing all the numbers from 1 to 1000 is -

(A) 12741 (B) 13946
(C) 4996 (D) 13501

Q.16 For a biased die the probabilities for the different faces to turn up are given below :

Faces :	1	2	3	4	5	6
Probabilities :	0.10	0.32	0.21	0.15	0.05	0.17

The die is tossed and you are told that either face one or face two has turned up. Then the probability that it is face one is -

(A) 1/6 (B) 1/10 (C) 5/49 (D) 5/21

Q.17 The smallest integer x for which the inequality $\frac{x-5}{x^2+5x-14} > 0$ is satisfied is given by -

(A) -6 (B) -5 (C) -4 (D) -3

Q.18 If x, y, z are unequal positive numbers in H.P., then $x^3 + z^3$

(A) $\geq 2y^3$ (B) $\leq 2y^3$

(C) $> 2y^3$ (D) none of these

Q.19 If in a ΔABC, $\tan A + \tan B + \tan C > 0$, then the triangle is -

(A) acute - angled

(B) obtuse – angled

(C) right - angled

(D) nothing can be said

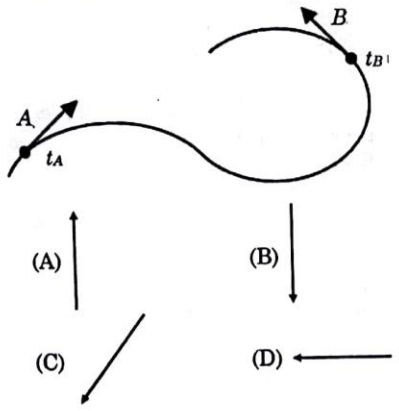
Q.20 If $\vec{e}_1$ & $\vec{e}_2$ are two unit vectors and θ is the angle between them, then $\sin\left(\frac{\theta}{2}\right)$ is -

(A) $\frac{1}{2}|\vec{e}_1 + \vec{e}_2|$ (B) $\frac{1}{2}|\vec{e}_1 - \vec{e}_2|$

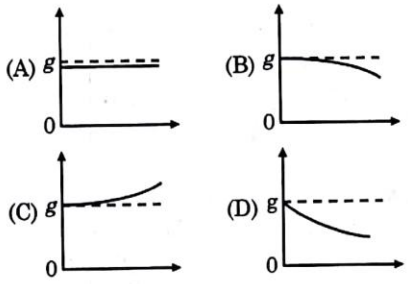
(C) $\frac{\vec{e}_1 \cdot \vec{e}_2}{2}$ (D) $\frac{|\vec{e}_1 \times \vec{e}_2|}{2|\vec{e}_1||\vec{e}_2|}$

PHYSICS

Q.21 An object travels along a path shown with changing velocity as indicated by vectors A and B. Which vector best represents the net acceleration of the object from time t_A to t_B?



Q.22 An object is dropped and accelerates downwards. As it falls it is affected by air friction, but never reaches terminal velocity during the course of its fall. The graph that could indicate the magnitude of the object's acceleration as a function of time is :



Q.23 An air track glider of mass M is built, consisting of two smaller connected gliders with a small explosive charge located between them. The glider is traveling along a frictionless rail at 2 m/s to the right when the charge is detonated, causing the smaller glider with mass $\frac{1}{4}M$, to move off to the right at 5 m/s. What is the final velocity of the second small glider ?

(A) 4 m/s to the left

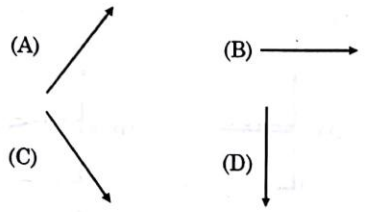
(B) 2 m/s to the left

(C) 1 m/s to the left

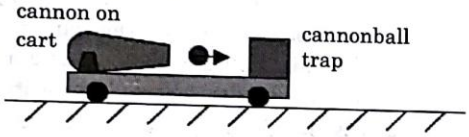
(D) 1 m/s to the right

Q.24 A billiard ball hits the side of a pool table at an angle θ as shown in the top view above, and bounces away at the same angle, and with the same speed. Which vector indicates the direction of the net change in momentum of the billiard ball?

View looking down on pool table

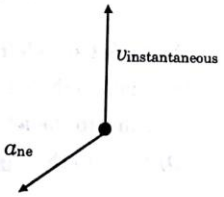


Q.25 A large cannon is mounted on a cart with frictionless wheels that is initially at rest on a horizontal surface. The cannon fires a large cannonball to the right with a speed $v_{cannonball}$, which is then caught by a trap firmly attached to the cart. What is the final speed v of the cannon-cart cannonball system?



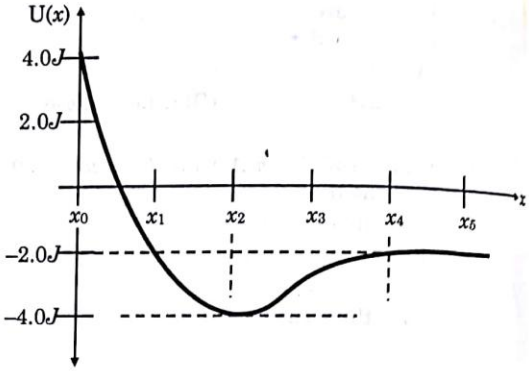
(A) $v > v_{cannonball}$, to the left
(B) $v > v_{cannonball}$, to the right
(C) 0
(D) $v < v_{cannonball}$, to the left

Q.26 The instantaneous velocity and net acceleration for an object moving in a circular path are shown. At this moment in time, the object is :



(A) speeding up in a clockwise circle
(B) slowing down in a clockwise circle
(C) speeding up in a counterclockwise circle
(D) slowing down in a counterclockwise circle

Q.27 The potential energy function $U(x)$ is associated with a conservative force F and described by the graph given here. If a particle being acted upon by this force has a kinetic energy of 1.0 J at position x_0, what is the particle's kinetic energy at position x_4?



(A) 6.0 J (B) 7.0 J (C) 2.0 J (D) –2.0 J

Q.28 A certain star, of mass m and radius r, is rotating with a rotational velocity ω. After the star collapses, it has the same mass but with a much smaller radius. Which statement below is true?

(A) The star's moment of inertia I has decreased, and its angular momentum L has increased
(B) The star's moment of inertia I has decreased, and its angular velocity ω has decreased
(C) The star's moment of inertia I remains constant, and its angular momentum L has increased
(D) The star's angular momentum L remains constant, and its rotational kinetic energy has increased

Q.29 A helium nucleus makes a full revolution in a circle of radius 0.8 m in 2 s. The magnetic field at the centre of the circle will be –

(A) $10^{-19}/\mu_0$ (B) $10^{-19}\ \mu_0$
(C) $2 \times 10^{-19}\mu_0$ (D) $2 \times 10^{-19}/\mu_0$

Q.30 A vertical straight conductor carries a current vertically upwards. A point P lies to the east of it at a small distance and another point Q lies to the west of it at the same distance. The magnetic field at P is (Consider earth magnetic field also) -

(A) greater than at Q
(B) same as at Q
(C) less than at Q
(D) greater or less than at Q depending upon the strength of the current

Q.31 A wire of length ℓ and carrying a current i is placed along X-axis in a magnetic field given by $\vec{B} = B_0(\hat{i} + \hat{j} + \hat{k})$. The magnitude of the force acting on the wire is –

(A) $B_0 i \ell$ (B) $\sqrt{2}\ B_0 i \ell$

(C) $2\ B_0 i \ell$ (D) $B_0 i \ell/\sqrt{2}$

Q.32 A charged particle projected perpendicularly into a magnetic field of $(7\hat{i} - 3\hat{j}) \times 10^{-3}$ tesla acquires an acceleration of $(x\hat{i} + 7\hat{j})$ ms^{-2}. The value of x is –

(A) 2m (B) 3m

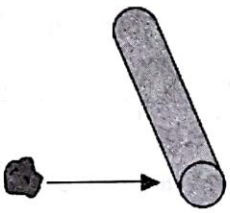
(C) 4m (D) 7m

Q.33 The voltage and the current of an a.c. circuit are V = 100 sin (100 t) volt and i = 100 sin (100 t + π/3) mA respectively. The power dissipated in the circuit is –

(A) 10^4 W (B) 10 W

(C) 2.5 W (D) 5.0 W

Q.34 An asteroid traveling through space collides with one end of a long, cylindrical satellite as shown and sticks to the satellite. Which of the following is true of the isolated asteroid-satellite system in this collision?



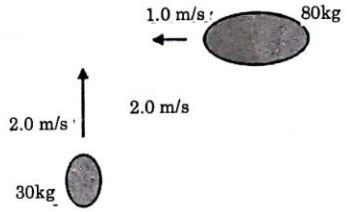
(A) Kinetic energy K is conserved

(B) Total Energy E is conserved, but angular momentum L is not conserved

(C) Angular momentum L is conserved, but linear momentum P is not conserved

(D) Angular momentum L is conserved, and total energy E is conserved

Q.35 Two ice skaters, of mass 30 kg and 80 kg, are skating across the surface of a frozen lake on a collision course, with respective velocities of 2.0 m/s in a general north direction, and 1.0 m/s generally west, as shown above. After they collide, the pair of skaters move off in a direction north of west with a momentum of approximately 100 kg m/s. How much kinetic energy was lost in the collision ?



(A) 0 J (B) 110 J (C) 55 J (D) 70 J

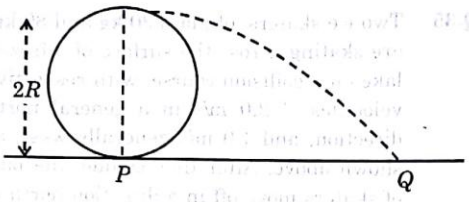
Q.36 An ideal monoatomic gas is heated so that it expands at constant pressure. What percentage of the heat supplied to the gas is used to increase the internal energy of the gas ?

(A) 100% (B) 0% (C) 60% (D) 50%

Q.37 When a tuning fork of frequency f is excited and held near one end of a straight pipe of length L open at both ends, the air column in the pipe vibrates in its fundamental mode and is in resonance with the tuning fork. The pipe is now kept vertical in a jar containing water so that half the length of the pipe is inside water. What should be the frequency of the tuning fork to be used to make the air column vibrate in its fundamental mode in resonance with the tuning fork now ?

(A) f (B) 2f (C) f/2 (D) f/4

Q.38 A wheel of radius R is rolling along a horizontal surface with a speed u. A pebble trapped on the wheel gets separated from the highest point of the wheel arrives at position P (figure). The horizontal range PQ of the pebble is :



(A) $u\sqrt{R/g}$ (B) $2u\sqrt{R/g}$

(C) $4u\sqrt{R/g}$) (D) $u^2\sqrt{R/g}$

Q.39 A particle starts from the origin at time $t = 0$ with velocity $2\hat{j}$ and moves in the x-y plane with a constant acceleration of $2\hat{i} + 4\hat{j}$ where $\hat{i}$ and $\hat{j}$ are unit vectors along the x-direction and y-direction respectively. What will be the x-coordinate of the particle when its y-coordinate becomes 12 m –

(A) 4 m (B) 6 m (C) 6.8 m (D) 8 m

Q.40 Two solid bodies rotate about stationary mutually perpendicular intersecting axes with constant angular velocities ω_1 and ω_2. What is the magnitude of angular velocity of one with respect to the other ?

(A) $\omega_1 - \omega_2$ (B) $\sqrt{\omega_1^2 + \omega_2^2}$

(C) $\sqrt{\omega_1^2 - \omega_2^2}$ (D) $\omega_1 + \omega_2$

CHEMISTRY

Q.41 (I) When copper ore is mixed with silica, in a reverberatory furnace copper matte is produced. The copper matte contains sulphides of copper (II) and iron (II).

(II) Zone refining is based on the principle that impurities are more soluble in molten metal than in solid metal.

(III) In the metallurgy of aluminium, graphite anode is oxidized to carbon monoxide and carbon dioxide.

Correct statements amongs the following are -

(A) I, II (B) II, III (C) I, III (D) I, II

Q.42 Among the following statements which is INCORRECT -

(A) In the preparation of compounds of Xe, Bartlett had taken O_2PtF_6 as a base compound because both O_2 and Xe have almost same ionization enthalpy.

(B) Nitrogen does not show allotropy.

(C) A brown ring is formed in the ring test for NO_3^- ion. It is due to the formation of $[Fe(H_2O)_5(NO)]^{2+}$

(D) On heating with concentrated NaOH solution in an inert atmosphere of CO_2, red phosphorus gives PH_3 gas

Q.43 The edge lengths of the unit cells in terms of the radius of spheres constituting fcc, bcc and simple cubic cell are respectively -

(A) $2r, \frac{4r}{\sqrt{3}}, 2\sqrt{2r}$ (B) $\frac{4r}{\sqrt{3}}, 2\sqrt{2r}, 2r$

(C) $2r, 2\sqrt{2r}, \frac{4r}{\sqrt{3}}$ (D) $2\sqrt{2r}, \frac{4r}{\sqrt{3}}, 2r$

Q.44 For a given reaction $A \rightarrow$ Product, rate is 1×10^{-4} Ms^{-1} when $[A] = 0.01$ M and rate is 1.41×10^{-4} Ms^{-1} when $[A] = 0.02$ M. Hence, rate law is -

(A) $-\frac{d[A]}{dt} = k[A]^2$ (B) $-\frac{d[A]}{dt} = k[A]$

(C) $-\frac{d[A]}{dt} = \frac{k}{4}[A]$ (D) $-\frac{d[A]}{dt} = k[A]^{1/2}$

Q.45 Which of the following is not correctly matched ?

(A) Sodium (ethylenediaminetetraacetato) chromate(II) – $Na_2[Cr(CH_3COO)_4(en)]$

(B) Dichloridobis (ethane-1, 2-diamine) cobalt(III) ion-$[Co(Cl)_2(en)_2)]^+$

(C) Tris(bipyridyl) iron(II)ion – $[Fe(NH_4C_5–C_5–H_4N)_3]^{2+}$

(D) Ammineaquadibromidocopper(II)– $[Cu(NH_3)(H_2O)Br_2]$

Q.46 The **incorrect** statement is -

(A) For coagulation of As_2S_3 sol, +ve ions are effective.

(B) For coagulation of aluminium hydroxide sol Ba^{2+} ions are more effective than Na^+

(C) Cellulose solution is an example of macromolecular colloid system

(D) Colloidal sol of metals such as gold, silver etc are prepared by Bredig's arc method.

Q.47 (I) V_2O_5, Cr_2O_3 are amphoteric oxides.

(II) Interstitial compounds are very reactive.

(III) In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine.

Correct statements amongs the following are -

(A) I, II (B) II, III (C) I, III (D) I, II

Q.48 The electrode potentials for

$Cu^{2+}_{(aq)} + e^- \rightarrow Cu^+_{(aq)}$ and $Cu^+_{(aq)} + e^- \rightarrow Cu_{(s)}$

Are + 0.15 V and + 0.50 V respectively. The value of $E^\circ_{Cu^{2+}/Cu}$ will be -

(A) 0.500 V (B) 0.325 V

(C) 0.650 V (D) 0.150 V

Q.49 $Na_2S_2O_3 \cdot 5H_2O$ sodium thiosulphate is used in photography to -

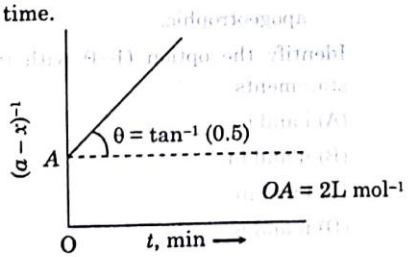
(A) remove reduced silver

(B) remove undecomposed AgBr as soluble silver thiosulphate complex

(C) convert the metallic silver to silver salt

(D) reduce the silver bromide grains to metallic silver

Q.50 Given is the graph between $(a - x)^{-1}$ and time.



Hence, rate at the start of the reaction is-

(A) 1.25 mol L^{-1} min^{-1}

(B) 0.125 mol L^{-1} min^{-1}

(C) 0.5 mol L^{-1} min^{-1}

(D) 1.25 mol min^{-1}

Q.51 The substances, P, Q and R have coagulation values 3, 0.6, 0.08 for a metal sol respectively. Their flocculating powers are in the ratio -

(A) 0.0267 : 5 : 1 (B) 1 : 5 : 37. 5

(C) 0.08 : 0.6 : 3 (D) 1 : 02 : 0.0267

Q.52 H_2S reacts with lead acetate forming a black compound which reacts with H_2O_2 to form another compound. The colour of the compound is -

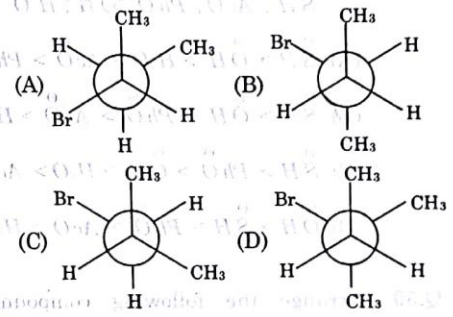
(A) pink (B) black (C) yellow (D) white

Q.53 In FCC lattice A, B, C, D atoms are arranged at corners, face centres, octahedral voids and tetrahedral voids respectively, then the body diagonal contains -

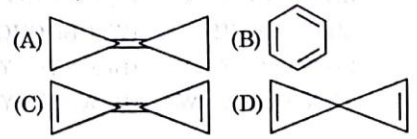
(A) 2A, 2D (B) 2A, C, 2D

(C) 2A, 2B, D (D) 2A, 2B, 2C

Q.54 Which of the Newman projections shown below represents the conformation about the C_1–C_1 bond of 1 Bromo-2-methylpropane ?



Q.55 A hydrocarbon C_6H_4 gives $C_3H_2O_3$ on ozonolysis. The hydrocarbon is -



Q.56 Which one of the following will not give white precipitate with ammonical silver nitrate solution -

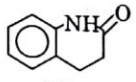
(A) $CH_3–C\equiv C–CH_3$

(B) $CH_3–\underset{\underset{CH_3}{|}}{CH}-C\equiv C-CH_3$

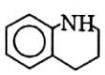
(C) $CH_3–CH_2–CH=CH_2$

(D) All of these

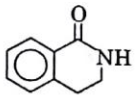
Q.57 Order of rate of electrophilic substitution reaction is -



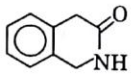
(P)



(Q)



(R)



(S)

(A) Q > P > S > R (B) Q > P > R > S

(C) P > Q > S > R (D) P > Q > R > S

Q.58 Decreasing order of relative nucleophilicity of the following nucleophiles in protic solvent is -

$\overset{\ominus}{S}H$, $Ac\overset{\ominus}{O}$, $Ph\overset{\ominus}{O}$, $\overset{\ominus}{O}H$, H_2O

(A) $\overset{\ominus}{S}H > \overset{\ominus}{O}H > H_2O > Ac\overset{\ominus}{O} > Ph\overset{\ominus}{O}$

(B) $\overset{\ominus}{S}H > \overset{\ominus}{O}H > Ph\overset{\ominus}{O} > Ac\overset{\ominus}{O} > H_2O$

(C) $\overset{\ominus}{S}H > Ph\overset{\ominus}{O} > \overset{\ominus}{O}H > H_2O > Ac\overset{\ominus}{O}$

(D) $\overset{\ominus}{O}H > \overset{\ominus}{S}H > Ph\overset{\ominus}{O} > Ac\overset{\ominus}{O} > H_2O$

Q.59 Arrange the following compounds in decreasing orders of rate of exchange of O^{18} with H_2O^{18} -

(X) CCl_3CHO (Y) CH_3CHO

(Z) CH_3COCH_3 (W) CBr_3CHO

(A) W > Z > X > Y (B) X > W > Y > Z

(C) X > Y > Z > W (D) W > Z > Y > X

Q.60 The enantiomeric excess and observed specific rotation of a mixture containing 6 gm (+)-2-butanol and 4 (gm) of (–)-2-butanol are respectively (If the specific rotation of enentiomerically pure (+)-2-butanol is + 13.5 unit).

(A) 80 %, + 2.7 unit

(B) 20%, –27 unit

(C) 20 %, + 2.7 unit

(D) 80 %, –27 unit

BIOLOGY

Q.61 Ribosomes are present in how many types of semiautonomous organelles in animal and plant cell respectively?

(A) One, two (B) Two, three

(C) Three, four (D) Two, one

Q.62 Which of the following statement is correct w.r.t. lenticels?

(A) Show exudation of droplets from bark surface

(B) Loss of solution having ψs as more negative

(C) Presence of closely arranged parenchymatous cells

(D) Restricted to tip of leaves

Q.63 Read the given statements:

(i) Cycas is a dioecious plant.

(ii) Female cone in cycas matures in about 3 years

(iii Ginko, Cycas and Equisetum resemble each other w.r.t. motile male gamete.

(iv) Coralloid roots in Pinus is apogeotrophic.

Identify the option (1–4) with two true statements

(A) i and ii

(B) ii and iii

(C) i and iii

(D) ii and iv

Q.64 Diplotene stage is characterized by all of these statements, except

(A) Extended and metabolically active in oocytes

(B) Dissolution of tripartite ladder like structure

(C) Can last for months or years

(D) Bivalents separate from each other at the site of crossing over

Q.65 Movement by diffusion is a slow process. It

(i) May involve transport proteins.

(ii) Is obvious in gases and liquids.

(iii) Is more likely in solids than of solids.

(iv) Requires ATP energy.

Identify the correct set of statements:

(A) i, ii and iv (B) i, ii and iii

(C) ii, iii and iv (D) iii and iv

Q.66 Nitrogen is absorbed by plants mainly as NO_3^- and finally reduced to ammonia mainly in

(A) Leaves (B) Roots

(C) Vascular tissues (D) Soil

Q.67 Which of the following features of C_4 plant shares with CAM plants?

(A) Dark acidification

(B) Mesophyll cell as the site of primary carboxylation

(C) Presence of photoactive stomata

(D) Similar value of transpiration ratio

Q.68 Identify the correct match :

(A) A haploid plant does not produce gametes

(B) Meiosis does not occur in haploid cells

(C) All plants form gametes by meiosis

(D) Mitosis cannot be the means for gamete formation

Q.69. Mendel's work on Pisum sativum shown that

(A) Alleles show blending inheritance

(B) F1 resembled either of the two parents

(C) In a dissimilar pair of factors, members of the pair are codominant

(D) Genotype of F2 tall plant can be determined by cross with recessive parent

Q.70 Read the following statements :

(a) Replication does not initiate randomly at any place in DNA.

(b) DNA polymerase on their own initiate DNA replication

(c) DNA replication if not coordinated with cell division cycle, it may results in polyploidy.

(d) Presence of exons is reminiscent of antiquity and the process of splicing represents the dominance of RNA-world

Find out the option with correct statement

(A) a, b and c (B) a and c

(C) b and c (D) a, b and d

Q.71 Sewage treatment process includes all of these features, except

(A) A small part of the activate sludge is pumped back into the aeration tank to serve as incoculum

(B) Activated sludge cannot be used in anaerobic digestion process

(C) Anaerobic bacteria digest aerobic bacteria in sludge digesters

(D) Transfer of primary effluent in aeration tanks.

Q.72 Pyramid of biomass in an aquatic habitats explains that –

(A) High standing crop of phytoplanktons supports a large standing crop of zooplanktons

(B) Energy at successive higher trophic level increases

(C) Phytoplanktons have shorter life span and high annual productivity

(D) Consumers cannot survive for long

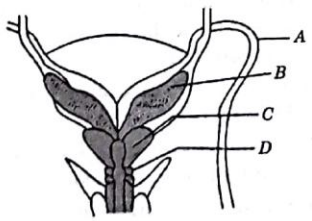
Q.73. Mark the correct option (w.r.t. biodiversity hot spots)
(A) Ex-situ conservation
(B) Cover more than 2% of the earth's land area
(C) Regions with accelerated habitat loss
(D) High frequency of ubiquitous species

Q.74 Inulin is a polymer of
(A) One glucose and one fructose molecules
(B) Many fructose molecules
(C) One glucose and galactose molecules
(D) Many N-acetylglucosamine molecules

Q.75 Which of the following carries a natural plasmid that can most effectively and exclusively be used in transforming plant cell only?
(A) Meloidgene incognita
(B) Bacillus thuringiensis
(C) Agrobacterium tumefaciens
(D) Escherichia coli

Q.76. The many projections on the wall of small intestine function to -
(A) Secrete digestive enzyme
(B) Increase the surface area
(C) Hold products of digestion so they do not enter the large intestine
(D) Hold mucus, so ulcer do not form

Q.77 Given below is a diagrammatic sketch of a portion of human male reproductive system. Select the correct set of the names of the parts labelled A, B, C, D



	A	B	C	D
(A)	Vas deferens	Semina vesicle	Bulboure-thral gland	Prostate
(B)	Ureter	Seminal vesicle	Prostate	Bulboure thral gland
(C)	Ureter	Prostate	Seminal vesicle	Bulboure thral gland
(D)	Vas deferens	Semina vesicle	Prostate	Bulboure-thral gland

Q.78 Gene therapy cures -
(A) Genetical disorders
(B) Nutritional defects
(C) Cataract
(D) Skin disorders

Q.79. Monoclonal antibodies are -
(A) Single parent type that attack many antigens
(B) Single parent type and attack specific antigen
(C) Various parent types and attack many antigens
(D) Various parent type and attack single antigen

Q.80 Which one of the following is the most widely accepted method of contraception in India, as at present ?
(A) IUDs (Intra uterine devices)
(B) Cervical caps
(C) Tubectomy
(D) Diaphragms

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 If $|z - 4 + 3i| \leq 1$ and α and β be the least and greatest values of $|z|$ and k be the least value of $\frac{x^4 + x^2 + 4}{x}$ on the interval $(0, \infty)$, then k is equal to-
(A) α (B) β
(C) $\alpha + \beta$ (D) None of these

Q.82 There are twenty bags each containing 10 bulbs and it is known that no bag contains more than 5 defective bulbs and 3 bags have 5 defective bulbs. 4 bags have atleast 4 defective bulbs, 5 bags have atleast 3 defective bulbs, 6 bags have atleast 2 defective bulbs and 7 bags have atleast 1 defective bulb. Then the ratio of total defective bulbs is to non-defective bulbs is –

(A) $\frac{4}{7}$ (B) $\frac{3}{7}$ (C) $\frac{2}{7}$ (D) $\frac{1}{7}$

Q.83 If S be the sum of coefficients in the expansion of $(px + qy - rz)^n$ (where p, q, $r > 0$), then the value of $\lim\limits_{n\to\infty} \frac{S}{(S^{1/n}+1)^n}$, is:

(A) $\frac{pq}{r}$ (B) $e^{\frac{pq}{r}}$ (C) 0 (D) 1

Q.84 If A, B and C are exhaustive events satisfying $P((A \cup B) \cap \overline{C}) = \frac{1}{5}$, $P(B \cap C) - P(A \cap B \cap C) = \frac{1}{15}$ and $P(A \cap C) = \frac{1}{10}$, then $P(C \cap (A \cup B)')$ is equal to-

(A) $\frac{17}{30}$ (B) $\frac{18}{30}$ (C) $\frac{19}{30}$ (D) $\frac{20}{30}$

Q.85 Coordinate of the vertices B and C of a triangle ABC are (2, 0) and (8, 0) respectively. The vertex A is varying in such a way that $4 \tan\frac{B}{2}\tan\frac{C}{2} = 1$. The locus of A is-

(A) $\frac{(x-5)^2}{25} + \frac{y^2}{16} = 1$

(B) $\frac{(x-5)^2}{16} + \frac{y^2}{25} = 1$

(C) $\frac{(x-5)^2}{25} + \frac{y^2}{9} = 1$

(D) $\frac{(x-5)^2}{9} + \frac{y^2}{25} = 1$

Q.86 If $g(x)$ is a differential real valued function satisfying $g''(x) - 3g'(x) > 3\ \forall x \geq 0$ and $g'(0) = -1$, then $g(x) + x$ for $x > 0$ is-

(A) an increasing function

(B) a decreasing function

(C) a constant function

(D) Data insufficient

Q.87 Let $n_1 = \sin 7 + \cos 7$, $n_2 = \sqrt{\sin 7} + \sqrt{\cos 7}$, $n_3 = \sqrt{1+\sin 14}$, $n_4 = 1$, then-

(A) $n_2 > n_3 > n_4 > n_1$

(B) $n_3 > n_4 > n_2 > n_1$

(C) $n_3 = n_1 > n_4 > n_2$

(D) $n_2 > n_1 = n_3 > n_4$

Q.88 If matrix $A = [a_{ij}]_{3\times3}$, matrix $B = [b_{ij}]_{3\times3}$, where $a_{ij} + a_{ji} = 0$ and $b_{ij} - b_{ji} = 0$, then $A^4 . B^3$ is -

(A) Idempotent matrix

(B) singular matrix

(C) symmetric matrix

(D) zero matrix

Q.89 If $f(x) = ae^{2x} + be^x + cx$ satisfies the conditions $f(0) = -1$, $f'(\log 2) = 31$ & $\int_0^{\ell n 4} (f(x) - cx)\,dx = \frac{39}{2}$, then -

(A) $a = 4$ (B) $b = -6$

(C) $c = 2$ (D) $a = 3$

Q.90 The value of the sum

$\frac{1}{3^2+1} + \frac{1}{4^2+2} + \frac{1}{5^2+3} + \frac{1}{6^2+4} + \ldots\infty$, is equal to -

(A) $\frac{13}{36}$ (B) $\frac{12}{36}$

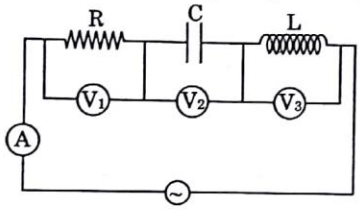
(C) $\frac{15}{36}$ (D) $\frac{18}{36}$

PHYSICS

Q.91 The focal length of a convex lens of refractive index 1.5 is 2 cm. The focal length of the lens when immerged in liquid spirit of refractive index 1.25 is -

(A) 5 m (B) 2.5 cm (C) 4 cm (D) 5 cm

Q.92 In the figure shown V_1, V_2 are AC voltmeters and A is AC ammeter. The readings of V_1, V_2, V_3 and A are 10 V, 20 V, 20V, 2A respectively. Find the values of R, C, L and the source voltage V_s. If the inductor is short circuit then what will be the reading of V_1, V_2 and A.

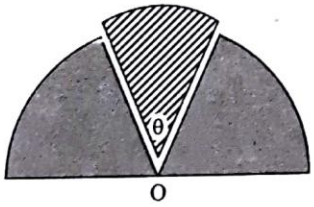


V_s, 50 Hz

(A) $2\sqrt{5}$ volts (B) $4\sqrt{5}$ volts

(C) $6\sqrt{5}$ volts (D) $8\sqrt{5}$ volts

Q.93 A segment of angle θ is cut from a half disc with symmetry of symmetrically as shown. If the centre of mass of the remaining part is at a distance 'a' from O and the centre of mass of the original disc was at distance d then it can be definitely said that -



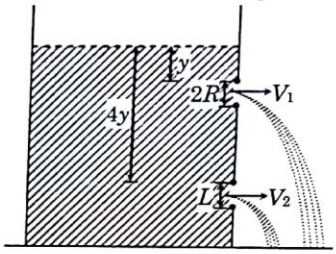
(A) $a = d$

(B) $a > d$

(C) $a < d$

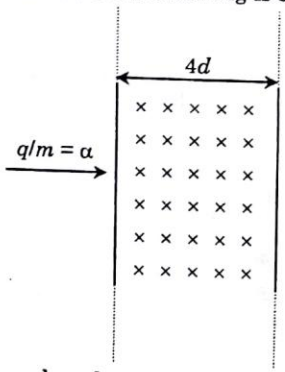
(D) A, B, C depends on the angle of segment cut from disc.

Q.94 A large open tank has two small holes in its vertical wall as shown in figure. One is a square hole of side 'L' at a depth '$4y$' from the top and the other is a circular hole of radius 'R' at a depth 'y' from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then, 'R' is equal to -



(A) $\frac{1}{\sqrt{2\pi}}$ (B) $2\pi L$ (C) $\sqrt{\frac{2}{\pi}}$. L (D) $\frac{L}{2\pi}$

Q.95 If a charged particle of charge to mass ratio $\frac{q}{m} = \alpha$ is entering in a magnetic field of strength B at a speed $v = (2\alpha d)(B)$, then which of the following is correct -



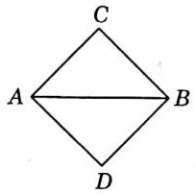
(A) angle subtended by charged particle at the centre of circular path is 2π.

(B) the charge will move on a circular path and will come out from magnetic field at a distance 4d from the point of insertion.

(C) the time for which particle will be in the magnetic field is $\frac{2\pi}{\alpha B}$.

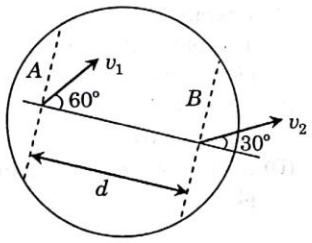
(D) the charged particle will subtend an angle of 90° at the centre of circular path.

Q.96 Two identical rectangular rods of metal are welded end to end in series between temperature 0°C and 100°C and 10 J of heat is conducted (in steady state process) through the rod in 2.00 min. If 5 such rods are taken and joined as shown in figure maintaining the same temperature difference between A and B, then the time in which 20 J heat will flow through the rods is -



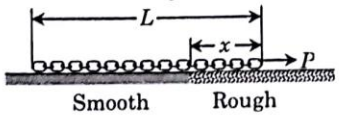
(A) 30 sec. (B) 2 min.
(C) 1 min. (D) 20 sec.

Q.97 Two points A and B on a disc have velocities v_1 & v_2 at some moment. Their directing make angles 60° and 30° respectively with the lnie of separation as shown in figure. The angular velocity of disc is -



(A) $\frac{\sqrt{3}v_1}{d}$ (B) $\frac{v_2}{\sqrt{3}d}$ (C) $\frac{v_2 - v_1}{d}$ (D) $\frac{v_2}{d}$

Q.98 A chain of length L is placed on a horizontal surface as shown in figure. At any instant x is the length of chain on rough surface and the remaining portion lies on smooth surface. Initially $x = 0$. A horizontal force P is applied to the chain (as shown in figure). In the duration x changes from $x = 0$ to $x = L$, for chain to move with constant speed.

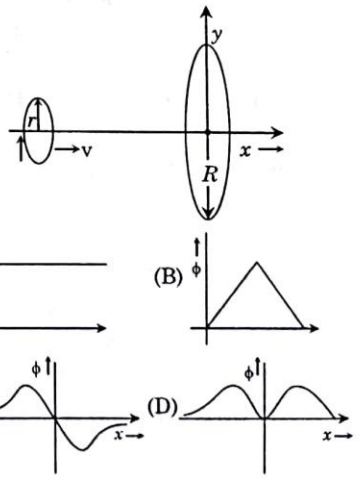


(A) the magnitude of P should increase with time
(B) the magnitude of P should decrease with time
(C) the magnitude of P should increase first and then decrease with time
(D) the magnitude of P should decrease first and then increase with time

Q.99 An object approaches a fixed diverging lens with a constant velocity from infinity along the principal axis. The relative velocity between object and its image will be -

(A) increasing
(B) decreasing
(C) first increases then decreases
(D) first decreases and then increases

Q.100 A ring of radius R is placed in the plane with its center at origin and its axis along the x-axis and having uniformly distributed positive charge. A ring of radius r ($<<R$)and coaxial with the larger ring is moving along the axis with constant velocity then the variation of electrical flux (ϕ) passing through the smaller ring with position will be best represented by -



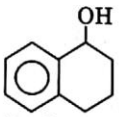
CHEMISTRY

Q-101 In the radioactive decay

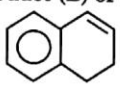
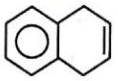
$${}_{Z}X^{A} \rightarrow {}_{Z+1}Y^{A} \rightarrow \underset{\text{high energy}}{{}_{Z-1}Z^{A-4}} \rightarrow \underset{\text{low energy}}{{}_{Z-1}Z^{A-4}}$$ the sequence of the radiation emitted is-

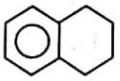
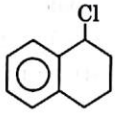
(A) α, β, γ (B) γ, α, β

(C) β, γ, α (D) β, α, γ

Q.102  $\xrightarrow[\text{Pyridine}]{\text{TsCl}}$ (A) $\xrightarrow[\text{OH}^{\ominus}/\Delta]{}$ (B);

Product (B) of the above reaction is-

(A)  (B) 

(C)  (D) 

Q.103 The reaction,

Sucrose $\xrightarrow{H^+}$ Glucose + Fructose, takes place at certain temperature while the volume of solution is maintained at 1 litre. At time zero the initial rotation of the mixture is 34°. After 30 minutes the total rotation of solution is 19° and after a very long time, the total rotation is –11°. Find the time when solution was optically inactive. (log 3 = 0.477, log 11 = 1.1) -

(A) 135 min (B) 103.7 min

(C) 38.7 min (D) 45 min

Q.104 Which of the following amine react with TsCl & then soluble in KOH

Product (N) is

(A) $CH_3 - NH - CH_3$

(B) $CH_3 - CH_2 - N(CH_3)_2$

(C) $CH_3 - NH_2$

(D) Ph_3N

Q.105 Calculate the potential of a half cell having reaction :

$Ag_2S(s) + 2e^- \rightleftharpoons 2Ag(s) + S^{2-}(aq)$ in a solution buffered at pH = 3 and which is also saturated with 0.1 M H_2S(aq). ($K_{a_1}.K_{a_2}$) $H_2S = 10^{-24}$, $K_{sp}(Ag_2S) = 10^{-49}$

(A) 1.18 (B) 0.19

(C) – 0.19 V (D) None

Q.106 Given the following molar conductivities at 25°C:, HCl, 426 $\Omega^{-1}cm^2$ mol^{-1} NaCl, 126 Ω^{-1} cm^2 mol^{-1}; NaC (sodium crotonate), 83 Ω^{-1} cm^2 mol^{-1}. What is the ionization constant of crotonic acid ? If the conductivity of a 0.001 M crotonic acid solution is 3.83×10^{-5} Ω^{-1} cm^{-1} ?

(A) 10^{-5} (B) 1.11×10^{-5}

(C) 1.11×10^{-4} (D) 0.01

Q.107 Which of the following is correct IUPAC name of any complex compound ?

(A) Tris (acetylacetonato) iron (III) chloride

(B) Hexachloroplatinum (IV) tetraammine dicyano palatinate (IV)

(C) Ammine bromochloro methylamine platinum (II)

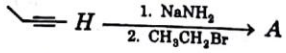
(D) cis-dichloro (ethylenediamine) platinum (II)

Q.108 If $\Delta_0 < P$, then what is electronic arrangement of metal atom/ion in complex with d^4 configuration ?

(A) t_{2g}^4, e_g^0 (B) e_g^4, t_{2g}^0

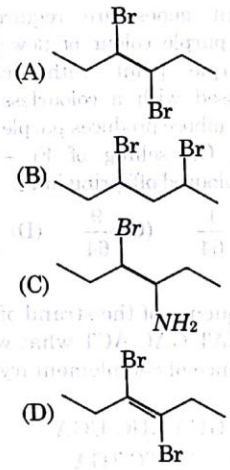
(C) t_{2g}^3, e_g^1 (D) e_g^2, t_{2g}^2

Q.109 What is the final product, C, of the following reaction sequence ?



$$A \xrightarrow{Na,\ NH_3\ (liq.)} B$$

$$B \xrightarrow[CH_2Cl_2]{Br_2} C$$

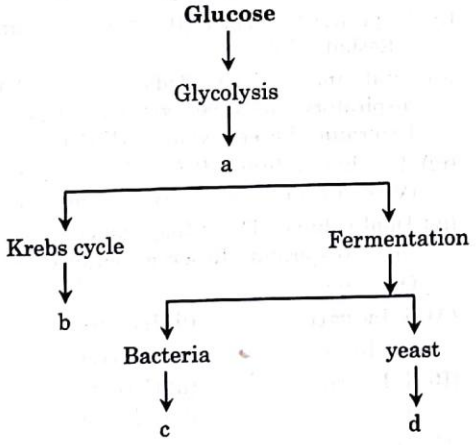


Q.110 Which not correctly matched

(A) O_2, F_2	S–P mixing of orbital
(B) Cl_2, Br_2	Undergo disproportionation
(C) PCl_5, BF_3	Dipole moment zero
(D) H_3PO_3	Dibasic acid

BIOLOGY

Q.111 Identify the products *a*, *b*, *c* & *d* and find out the correct option.



(A) a → Pyruvic acid
b → $CO_2 + H_2O$
c → Ethyl alcohol + CO_2
d → Lactic Acid

(B) a → Pyruvic acid
b → Ethyl alcohol + CO_2
c → Lactic acid
d → $CO_2 + H_2O$

(C) a → $CO_2 + H_2O$
b → Pyruvic acid
c → Ethyl alcohol + CO_2
d → Lactic Acid

(D) a → Pyruvic acid
b → $CO_2 + H_2O$
c → Lactic acid
d → Ethyl alcohol + CO_2

Q.112 Which of the following statement are correct for asexual reproduction ?

(a) It is uniparental
(b) There is no variation and the offspring have the same phenotype & genotype
(c) It does not contribute to evolution & speciation
(d) Both mitotic & meiotic cell division involve

(A) a, b & c (B) b & d
(C) c & d (D) a, b & d

Q.113 (a) The female of many primates, including human's have .....(i) ..... cycle, in which the .....(ii)..... is shed.
(b) Whereas other animals have ..... (iii) cycle.
(c) During the first 14 days of the menstrual cycle growth of the follicle is promoted by ..... (iv)

	(i)	(ii)	(iii)	(iv)
(A)	Estrous cycle	Endometrium	Menstrual cycle	LH
(B)	Menstrual cycle	progesterone	Estrous cycle	LH
(C)	Estrous cycle	Myometrium	Menstrual cycle	FSH
(D)	Menstrual cycle	Endometrium	Estrous cycle	FSH

Q.114 Stratosphere -

(i) begin at the top of the tropopause

(ii) includes much of ozone layer

(iii) Zone is above 80 km altitude

Which statement are correct

(A) (i) & (ii) only

(B) (i) & (iii) only

(C) (i) only

(D) (ii) & (iii) only

Q.115 A married couple adopted a male child. A few years later twin boys were born to them. The blood group of the couple is AB positive and *O* negative. The blood group of the three sons is *A* positive, *B* positive and *O* positive. The blood group of the adopted son is -

(A) *O* positive

(B) *A* positive

(C) *B* positive

(D) Cannot be determined on the basis of the given data

Q.116 Match the names of disease listed under column-I with meanings given under column-II, choose the answer which gives the correct combination of the alphabets of the columns.

Column-I (Name of disease)	**Column-II (meanings)**
(a) Jaundice	(p) Allergic inflammation of nose
(b) Stenosis	(q) Loss of motor Functions
(c) Rhinitis	(r) Heart valve defect
(d) Paralysis	(s) Increase in bile pigments in the blood
	(t) Septal defect of heart

(A) a = q; b = t; c = r; d = P

(B) a = s; b = p; c = q; d = r

(C) a = s, b = r; c = p; d = q

(D) a = s; b = t; c = p; d = q

Q.117 ABC dominant genes are required for production of purple colour of flower in a plant. A purple plant with genotype AABBCC crossed with a colourless plant with genotype aabbcc produces purple colour in F_1 hybrid. On selfing of F_1 – what proportion of coloured offspring in F_2.

(A) $\frac{27}{64}$ (B) $\frac{1}{64}$ (C) $\frac{9}{64}$ (D) $\frac{37}{64}$

Q.118 If the base sequence of the strand of DNA is CAT ATC CAT GAC ACT what will be the base sequence of complementary RNA strand ?

(A) GUA UAG GUA CUG UGA

(B) GUT TAG GTA GTC TGA

(C) GUA UAG GTA CUG UGA

(D) GTA TAG GTA CTG TGA

Q.119 Bakane disease in paddy is caused by -

(A) Abscisic acid

(B) Gibberellic acid

(C) Phenyl acetic acid

(D) Napthalene acetic acid

Q.120 Identify the correct and incorrect match about respiratory volume end capacities and mark the correct answer.

(i) Inspiratory capacity (IC) = Tidal volume + Residual volume

(ii) Vital capacity (VC) = Tidal volume (TV) + inspiratory Reserve volume (IRV) + Expiratory Reserve volume (ERV)

(iii) Residual volume (RV) = Vital capacity (VC) – Inspiratory Reserve volume (IRV)

(iv) Tidal volume (TV) = Inspiratory capacity (IC) – Inspiratory Reserve volume (IRV)

Option :

(A) (i) Incorrect, (ii) Incorrect, (iii) Incorrect, (iv) Correct

(B) (i) Incorrect, (ii) Correct, (iii) Incorrect, (iv) Correct

(C) (i) Correct, (ii) Correct, (iii) Incorrect, (iv) Correct

(D) (i) Correct, (ii) Incorrect, (iii) Correct, (iv) incorrect

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-2

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 If the pairs of lines $x^2 + 2xy + ay^2 = 0$ and $ax^2 + 2xy + y^2 = 0$ have exactly one line in common then the joint equation of the other two lines can be-

(A) $3x^2 + 8xy - 3y^2 = 0$

(B) $3x^2 + 10xy + 3y^2 = 0$

(C) $y^2 + 2xy - 3x^2 = 0$

(D) $x^2 + 2xy - 3y^2 = 0$

Q.2 If $\log_\alpha 8 = \gamma$, $\log_\beta \alpha = -1$ and $\log_{1/4} \beta = -1$ then $\left(\frac{1}{\alpha}+1\right)^{\log_{\sqrt{5}}(\beta^2+4\gamma^2)}$ is equal to-

(A) $\sqrt{5}$ (B) 5 (C) 25 (D) 625

Q.3 If the ellipse $\frac{x^2}{4}+\frac{y^2}{1} = 1$ meet the ellipse $\frac{x^2}{1}+\frac{y^2}{a^2} = 1$ in four distinct points and $a = b^2 - 10b + 25$ then the value of b does not satisfy-

(A) $(-\infty, 2)$ (B) $(2, 3)$

(C) $(6, \infty)$ (D) $(4, 6)$

Q.4 The mean of 63 children on an arithmetic test are respectively 27.6 and 7.1. To them are added a new group of 26 who had less training and whose mean is 19.2 and S.D. 6.2. The value of the combined group differ from the original as to the mean is

(A) 25.1 (B) 2.3 (C) 1.5 (D) 2.5

Q.5 The function $f(x) = 0$ has eight distinct real solutions and f also satisfy $f(4 + x) = f(4 - x)$. The sum of all the eight solutions of $f(x) = 0$ is -

(A) 12 (B) 32 (C) 16 (D) 15

Q.6 Let the tangent to the curve $\sqrt{x}+\sqrt{y}=\sqrt{a}$ $(a > 0)$ at any point on it cuts the coordinate axes at P and Q. Then $OP + OQ$, where O is origin is equal to-

(A) a (B) $2a$ (C) a^2 (D) $\sqrt{a}$

Q.7 The three planes $4y + 6z = 5$, $2x + 3y + 5z = 5$ and $6x + 5y + 9z = 10$ -

(A) meet in a point

(B) have a line in common

(C) form a triangular prism

(D) none of these

Q.8 For every $x \in R$ the value of the expression $y = \frac{x^2}{8} + x\cos x + \cos 2x$ is never less than –

(A) –1 (B) 0 (C) 1 (D) 2

Q.9 If $\text{Re}\left(\frac{z-2i}{z+1}\right) = 1$, then the locus of the point representing z in the complex plane is -

(A) circle (B) a straight line

(C) parabola (D) none of these

Q.10 Before a race, the chances of three runners A, B and C were estimated to be proportional to 5 : 3 : 2, but during the race, A meets with an accident which reduces his chance to 1/3. The respective chances of B and C now winning are -

(A) $\frac{3}{5},\frac{2}{5}$ (B) $\frac{2}{5},\frac{4}{15}$

(C) $\frac{7}{15},\frac{2}{15}$ (D) $\frac{3}{10},\frac{2}{10}$

Q.11 Solution of the differential equation $\frac{dy}{dx}=\frac{y(x-y\ell ny)}{x(x\ell nx-y)}$

(A) $\frac{x\ell nx+y\ell ny}{xy}=C$

(B) $\frac{x\ell nx-y\ell ny}{xy}=C$

(C) $\frac{\ell nx}{x}+\frac{\ell ny}{y}\neq C$

(D) $\frac{\ell nx}{x}-\frac{\ell ny}{y}=C$

Q.12 A triangle has base 10 cm long and the base angles of 50° and 70°. If the perimeter of the triangle is $x + y\cos z^\circ$, where $z \in (0, 90^\circ)$, then the value of $x + y + z$ equals –

(A) 60 (B) 55 (C) 50 (D) 40

Q.13 Let $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$, $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$ and $\vec{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$ be three non zero vectors such that $|\vec{c}| = 1$, angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{4}$ and $\vec{c}$ is perpendicular to $\vec{a}$ and $\vec{b}$, then

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}^2 = \lambda(a_1^2 + a_2^2 + a_3^2)(b_1^2 + b_2^2 + b_3^2)$$

where λ is equal to

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) 1 (D) 2

Q.14. When 1! + 2! + 3! + 4! + ... + 2009! is divided by 35, then remainder will be –

(A) 31 (B) 32 (C) 33 (D) 36

Q.75 Solution set of the equation

$3^{2x^2} - 2.3^{x^2+x+6} + 3^{2(x+6)} = 0$ is -

(A) {–3, 2} (B) {6, –1}

(C) {–2, 3} (D) {1, –6}

Q.16 If $f(\theta) = \frac{1-\sin 2\theta+\cos 2\theta}{2\cos 2\theta}$, then value of $f(11°)\, f(34°)$ equals -

(A) $\frac{1}{2}$ (B) $\frac{3}{4}$

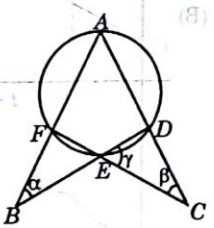
(C) $\frac{1}{4}$ (D) None of these

Q.17 The value of $\int_{-2}^{2} \frac{\sin^2 x}{[x/\pi]+1/2} dx$, where [ ] represent G.I.F-

(A) 1 (B) 0

(C) 4 – sin4 (D) None

Q.18 Consider the figure & find $\alpha+\beta+\gamma$ if $\frac{\alpha}{2} = \frac{\beta}{3} = \frac{\gamma}{2}$



(A) 100° (B) 120° (C) 140° (D) 210°

Q.19 Sum of the real values of 'a' for which the equation

$(a^2-3a+2)x^2+(a^2-4a+3)x+(a^2-6a+5)=0$ possess three distinct roots is given by -

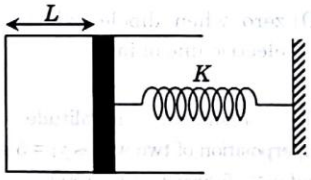
(A) 11 (B) 10 (C) 1 (D) None

Q.20 $\int_0^{10} f(x)dx = 5$, then $\sum_{k=1}^{10}\int_0^1 f(k-1+x)dx$ is equal to-

(A) 50 (B) 10 (C) 5 (D) None

PHYSICS

Q.21 A fixed container is fitted with a piston which is attached to a spring of spring constant k. The other end of the spring is attached to a rigid wall. Initially the spring is in its natural length and the length of container between the piston and its side wall is L. Now an ideal diatomic gas is slowly filled in the container so that the piston moves quasistatically. If pushed the piston by x so that the spring now is compressed by x. The total rotational kinetic energy of the gas molecules in terms of the displacement x of the piston is (there is vacuum outside the container)



(A) kxL (B) $4kxL$

(C) $kx\,(x+L)$ (D) $\frac{2kx^2}{L}$

Q.22 A battery of internal resistance 2Ω is connected to a variable resistor whose value can vary from 4Ω to 10Ω. The resistance is initially set at 4Ω. If the resistance is now increased then -

(A) power consumed by it will decrease

(B) power consumed by it will increases

(C) power consumed by it may increase or may decrease

(D) power consumed will first increase then decreases

Q.23 Two identical spheres of same mass and specific gravity (which is the ratio of density of a substance and density of water) 2.4 have different charges of Q and $-3Q$. They are suspended from two strings of same length ℓ fixed to points at the same horizontal level, but distant ℓ from each other. When the entire set up is transferred inside a liquid of specific gravity 0.8. It is observed that the inclination of each string in equilibrium remains unchanged. Then the dielectric constant of the liquid is -

(A) 2 (B) 3

(C) 1.5 (D) none of these

Q.24 Total electric force on an electric dipole placed in an electric field of a point charge is -

(A) always zero

(B) never zero

(C) zero when mid point of dipole coincides with the point charge

(D) zero when dipole axis is along any electric line of force

Q.25 The resultant amplitude due to superposition of two waves $y_1 = 5 \sin(\omega t - kx)$ and $y_2 = -5\cos(\omega t - kx - 150°)$

(A) 5 (B) $5\sqrt{3}$

(C) $5\sqrt{2-\sqrt{3}}$ (D) $5\sqrt{2+\sqrt{3}}$

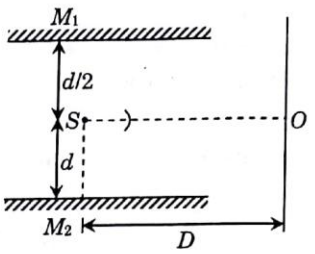
Q.26 The element which has a k_α x-rays line of wavelength 1.8 Å is –

($R = 1.1 \times 10^7\ m^{-1}$, $b = 1$ and $\sqrt{5/33} = 0.39$)

(A) Co, $Z = 27$ (B) Iron, $Z = 26$

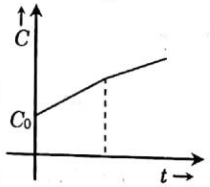
(C) Mn, $Z = 25$ (D) Ni, $Z = 28$

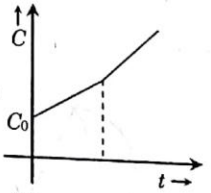
Q.27 M_1 and M_2 are plane mirrors and kept parallel to each other. At point O there will be maxima for wavelength. Light from monochromatic source S of wavelength λ is not reaching directly on the screen. The λ is – [$D >> d$, $d >> \lambda$]

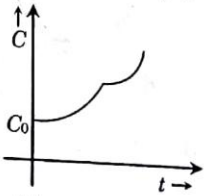


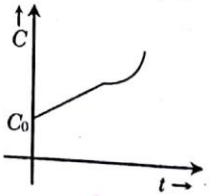
(A) $\frac{3d^2}{D}$ (B) $\frac{3d^2}{2D}$ (C) $\frac{d^2}{D}$ (D) $\frac{2d^2}{D}$

Q.28 A parallel plate capacitor without any dielectric has capacitance C_0. A dielectric slab is made up of two dielectric slabs of dielectric constants K and $2K$ and is of same dimensions as that of capacitor plates and both the parts are of equal dimensions arranged serially as shown. If this dielectric slab is introduced (dielectric K enters first) in between the plates at constant speed, then variation of capacitance with time will be best represented by -

(A)


(B)


(C)


(D)


Q.29 An object is moving in a circle at constant speed v. The magnitude of rate of change of momentum of the object -

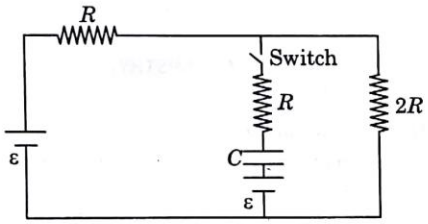
(A) is zero

(B) is proportional to v

(C) is proportional to v^2

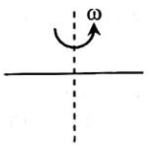
(D) is proportional to v^3

Q.30 Initially the capacitor was uncharged. Current in the capacitor just after switching on will be ?



(A) $\frac{\varepsilon}{R}$ (B) $\frac{\varepsilon}{2R}$ (C) $\frac{\varepsilon}{5R}$ (D) $\frac{\varepsilon}{4R}$

Q.31 A uniform rod of length L is charged uniformly with charge q and is rotating about an axis passing through its centre and perpendicular to rod. Magnetic moment of the rod is -



(A) $\frac{qL^2\omega}{6}$ (B) $\frac{qL^2\omega}{12}$ (C) $\frac{qL^2\omega}{24}$ (D) $\frac{qL^2\omega}{36}$

Q.32 Two magnets are dropped along the axis of two metallic tubes of finite length. One is of copper and the other of iron. Then -

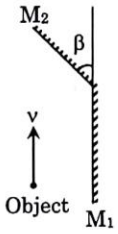
(A) magnet will come out from both the tubes simultaneously

(B) magnet will take longer time to travel through iron tube than copper tube.

(C) magnet will take longer time to travel through copper tube than iron tube

(D) none of these

Q.33 A object is moving with velocity v (w.r.t. earth) parallel to plane mirror M_1. Another plane mirror M_2 makes an angle β with the vertical as shown in figure. Then velocity of image in mirror M_2 w.r.t. the image in M_1 is -

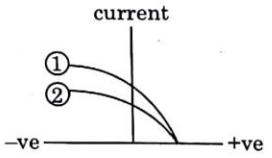


(A) 2 v sin β (B) v cos 2 β

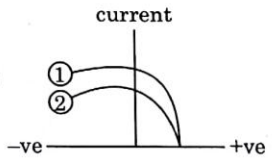
(C) 2v sin β (D) $v\sqrt{2}$

Q.34 The graph between photo electric current and cathode potential when the anode is kept at zero potential, for light of two different intensities out of the same frequency looks like the one -

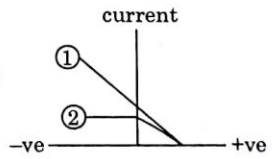
(A)



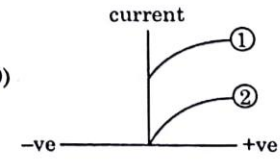
(B)



(C)



(D)



Q.35 Two SHM are represented by equations,

$y_1 = 6\cos\left(6\pi t + \frac{\pi}{6}\right), y_2 = 3(\sqrt{3}\sin 3\pi t + \cos 3\pi t)$

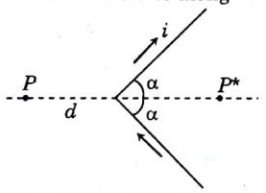
(A) ratio of their amplitudes is 1
(B) ratio of their time periods is 1
(C) ratio of their maximum velocities is 1
(D) ratio of their maximum acceleration is 1

Q.36 There are three concentric thin spheres of radius a, b, c ($a > b > c$). The total surface charge densities on their surfaces are σ, $-\sigma$ and σ respectively. The magnitude of electric field at r (distance from center) such that $a > r > b$ is -

(A) 0 (B) $\frac{\sigma}{\epsilon_0 r^2}(b^2 - c^2)$

(C) $\frac{\sigma}{\epsilon_0 r^2}(a^2 + b^2)$ (D) none of these

Q.37 The direction of field B at a point P symmetric to P with respect to the vertex, i.e., along the axis and the same distance d, but inside the V is along -



(A) positive z-axis (B) negative x-axis
(C) negative z-axis (D) negative y-axis

Q.38 A thin prism of glass is placed in air and water successively. If ${}_a\mu_g$ = 3/2 and ${}_a\mu_w$ = 4/3, then the ratio of deviation produced by the prism for a small angle of incidence when placed in air and water is -
(A) 9 : 8 (B) 4 : 3 (C) 3 : 4 (D) 4 : 1

Q.39 A wire of fixed length is wound in such a way that it forms a solenoid of length 'ℓ' and radius 'r'. Its self inductance is found to be L. Now if same wire is wound in such a way that it forms a solenoid of length $\frac{\ell}{2}$ and radius $\frac{r}{2}$, then the self inductance will be -
(A) 2L (B) L (C) 4L (D) 8L

Q.40 Two identical samples (same material and same amount) P and Q of a radioactive substances having mean life T are observed to have activities A_P & A_Q respectively at the time of observation. If P is older than Q, then the difference in their ages is -

(A) $T\,\ell n\left(\frac{A_P}{A_Q}\right)$ (B) $T\,\ell n\left(\frac{A_Q}{A_P}\right)$

(C) $\frac{1}{T}\,\ell n\left(\frac{A_P}{A_Q}\right)$ (D) $T\left(\frac{A_P}{A_Q}\right)$

CHEMISTRY

Q.41 The polymerization of ethylene to linear polyethylene is represented by the reaction :

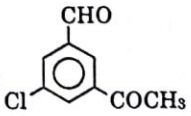
$nCH_2 = CH_2 \rightarrow [-CH_2-CH_2-]_n$ where n has large integral value. Given that the average enthalpies of bond dissociation for C = C and C – C at 298 K are 590 and 331 kJ mol^{-1} respectively, calculate the enthalpy of polymerization per mol of ethylene at 298 K.

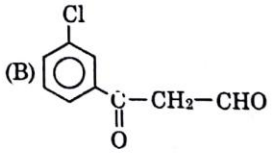
(A) –160 kJ/mol (B) –72 kJ/mol
(C) –114 kJ/mol (D) –36 kJ/mol

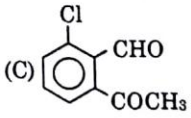
Q.42 Element A burns in nitrogen to give an ionic compound B. Compound B reacts with water to give C and D. A solution of C becomes 'milky' on bubbling carbon dioxide. Identify A, B, C and D.

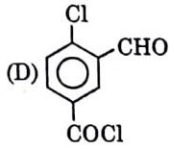
(A) S, S_3N_2, SO_2
(B) C, C_2N_2, NH_3
(C) Fe, FeO, $Fe(OH)_2$
(D) Ca, Ca_3N_2, $Ca(OH)_2$

Q.43 Compound A of molecular formula $C_9H_7O_2Cl$ exists in ketoform and predominatly in enolic form B. On oxidation with $KMnO_4$, A gives m-chlorobenzoic acid. Identify A and B.

(A) 

(B) 

(C) 

(D) 

Q.44 Complete the following reaction :

$$CH_3COOH \xrightarrow{?} ClCH_2COOH \xrightarrow{\text{excess } NH_3} ?$$

(A) C_2H_5OH, CH_3COONH_2

(B) HCl, $Cl–CH_2COONH_2$

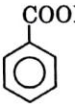
(C) OH^-, CH_3COONH_2

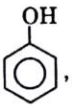
(D) P + Cl_2, $H_2N–CH_2COONH_4$

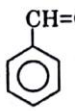
Q.45 Name the products in the following reaction :

$$C_6H_5CHO + CH_3COOC_2H_5 \xrightarrow[C_2H_5OH \text{ and heat}]{NaOC_2H_5 \text{ in absolute}} ?$$

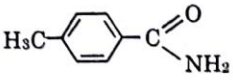
(A) $C_6H_5CH=CH-COOC_2H_5$

(B)  , C_2H_5COOH

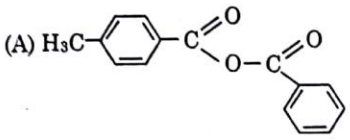
(C)  , $C_2H_5CH=CH_2$

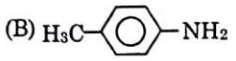
(D)  , C_2H_5OH

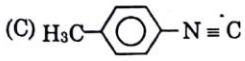
Q.46 In the reaction

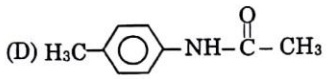


the structure of the product T is-

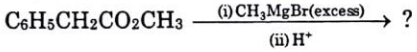
(A) 

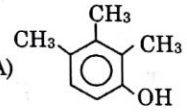
(B) 

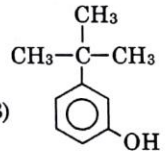
(C) 

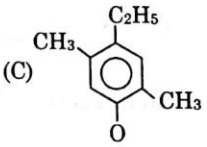
(D) 

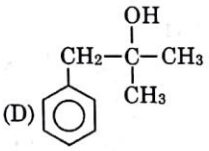
Q.47 Name the products in the following reaction :



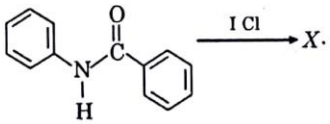
(A) 

(B) 

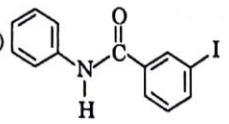
(C) 

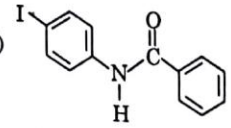
(D) 

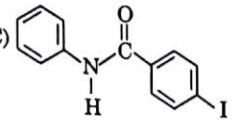
Q.48 In the following reaction ;

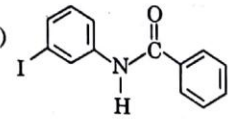


The structure of major product X is-

(A) 

(B) 

(C) 

(D) 

Q.49 $2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$. If nitrosyl bromide (NOBr) is 40% dissociated at certain temperature and a total equilibrium pressure of 0.30 atm. K_p for the reaction $2NO(g) + Br_2(g) \rightleftharpoons 2NOBr(g)$ is-

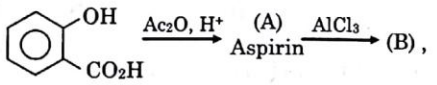
(A) 45 (B) 25 (C) 0.022 (D) 0.25

Q.50 H_2A is a weak triprotic acid ($K_{a_1} = 10^{-6}$, $K_{a_2} = 10^{-9}$, $K_{a_3} = 10^{-13}$) ; What is the value of pX of 0.1 M H_3A (aq.) solution ?

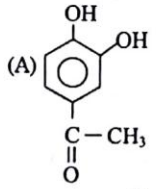
where $pX = -\log X$ and $X = \dfrac{[A^{3-}]}{[HA^{2-}]}$

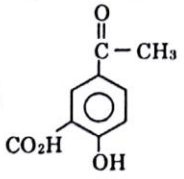
(A) 7 (B) 8 (C) 9 (D) 10

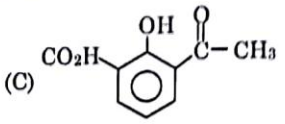
Q.51

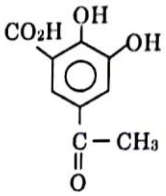


Product (*B*) in this reaction is-

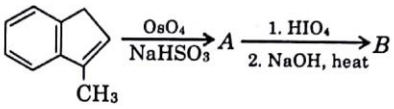
(A) 

(B) 

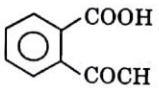
(C) 

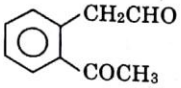
(D) 

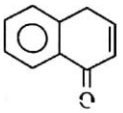
Q.52 Consider the following sequence of reactions.

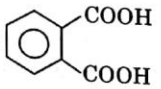


The final product (*B*) is-

(A) 

(B) 

(C) 

(D) 

Q.53 A 0.60 g sample consisting of only CaC_2O_4 and MgC_2O_4 is heated at 500°C, converting the two salts of $CaCO_3$ and $MgCO_3$. The sample then weighs 0.465 g. If the sample had been heated to 900°C, where the products are CaO and MgO, what would the mixtures of oxides have weighed ?

(A) 0.12 g (B) 0.21 g

(C) 0.252 g (D) 0.3 g

Q.54 $H_2O_2 + 2KI \xrightarrow{40\%\text{ yield}} I_2 + 2KOH$

$H_2O_2 + 2KMnO_4 + 3H_2SO_4 \xrightarrow{50\%\text{ yield}} K_2SO_4 + 2MnSO_4 + 3O_2 + 4H_2O$

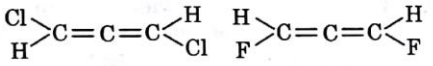
150 mL of H_2O_2 sample was divided into two parts. First part was treated with KI and formed KOH required 200 mL of M/2 H_2SO_4 for neutralization. Other part was treated with $KMnO_4$ yielding 6.74 litre of O_2 at STP. Using % yield indicated find volume strength of H_2O_2 sample used.

$H_2O_2 + 2KI \xrightarrow{40\%\text{ yield}} I_2 + 2KOH$

$H_2O_2 + 2KMnO_4 + 3H_2SO_4 \xrightarrow{50\%\text{ yield}} K_2SO_4 + 2MnSO_4 + 3O_2 + 4H_2O$

(A) 5.04 (B) 10.08 (C) 3.36 (D) 33.6

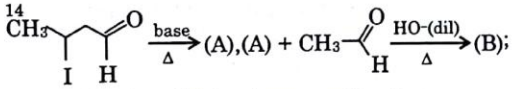
Q.55 Choose the correct option for the following molecule in view of chemical bonding :



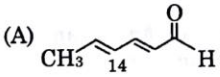
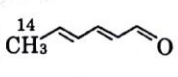
(A) non-planar (B) $\mu \neq 0$

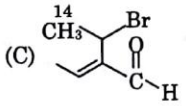
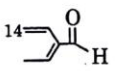
(C) (A) and (B) both (D) $\mu = 0$

Q.56

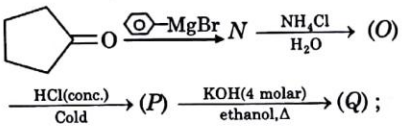


Product (B) in above reaction is-

(A)  (B) 

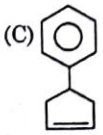
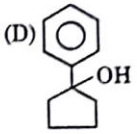
(C)  (D) 

Q.57



Product (Q) will be-

(A)  (B) 

(C)  (D) 

Q.58 Structure of $Na_2[B_4O_5(OH)_4].8H_2O$ contains-

(A) two triangular and two tetrahedral units

(B) three triangular and one tetrahedral units

(C) all tetrahedral units

(D) all triangular units

Q.59 Which of the following pair is incorrectly matched ?

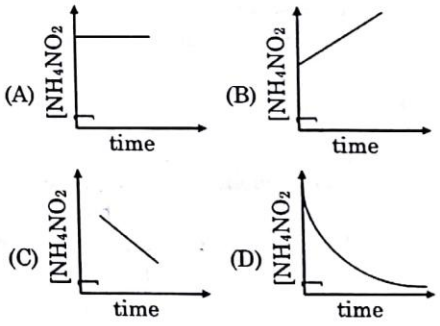
(A) van Arkel method – Zirconium

(B) Kroll's process – Titanium

(C) Froth Floatation – Cerussite

(D) Distillation – Zinc

Q.60 Decomposition of $NH_4NO_2(aq)$ into $N_2(g)$ and $2H_2O(\ell)$ is first order reaction. Which of the following graph is correct ?



BIOLOGY

Q.61 Choose the wrong statement regarding AIDS -

(A) AIDS is an immunodeficiency disease

(B) It is caused by a retrovirus, HIV

(C) HIV selectively infects and kill B-lymphocytes

(D) Viral RNA genome is converted into DNA copy by reverse transcriptase.

Q.62 Allergy involves -
(A) IgE (B) IgG (C) IgA (D) IgM

Q.63 What is ratio of homozygous plants for both dominant characters in F_2 of a dihybrid cross -
(A) 1/16 (B) 3/16 (C) 4/16 (D) 9/16

Q.64 The m-RNA, AUGCAGGAUCGU recognizes four amino acid and this character of the code referred to as -
(A) Degeneracy (B) Universality
(C) Non-ambiguity (D) Commalessness

Q.65 Uricotelism is found in -
(A) Birds, reptiles and insects
(B) Frogs and toads
(C) Mammals and birds
(D) Fishes and fresh water protozoans

Q.66 Leaf fall occurs as abscission layer is formed when the content of -
(A) Auxin increases
(B) Auxin decreases
(C) Abscisic acid decreases
(D) Gibberellic acid decreases

Q.67 The intermediate lobe of the pituitary gland produces a secretion which causes a dramatic darkening of the skin of many fishes, amphibians and reptiles. It is -
(A) Adrenocorticotropic hormone (ACTH)
(B) Follicle stimulating hormone (FSH)
(C) Melanocyte stimulating hormone (MSH)
(D) Luteinizing hormone (LH)

Q.68 The mineral element in chlorophyll and haemoglobin is respectively -
(A) Ca and Mg (B) Co and Fe
(C) Mg and Fe (D) Cd and Fe

Q.69 Largest amount of phosphate bond energy is produced in the process of respiration during -
(A) Anaerobic respiration
(B) Glycolysis
(C) Kreb's cycle
(D) none of the above

Q.70 Which one is not correct about Krebs' cycle -
(A) It is also called citric acid cycle
(B) The intermediate compound which links glycolysis with Krebs' cycle is malic acid
(C) It occurs in mitochondria
(D) It starts with six carbon compound

Q.71 Dimorphic chloroplasts are present in -
(A) Sugarcane (B) Cotton
(C) Pea (D) Mango

Q.72 Reflex action immediately involves -
(A) Spinal cord
(B) Cerebellum
(C) Medulla oblongate
(D) optical lobe

Q.73 The best stage to view structure, size and to count the number of chromosomes is -
(A) Metaphase (B) Late prophase
(C) Early anaphase (D) I-phase

Q.74 Statements -
(a) The element which is very important for the production of thyroxine is iodine.
(b) Vitamin B_6 is otherwise known as niacin or nicotinic acid.
(c) Fructose is a monosaccharide and is a hexose sugar.
(d) Globulin is an example for a conjugated protein.
Which option is true -
(A) a, b and c are correct but d is wrong
(B) a and c are correct but b and d are wrong
(C) a and b are correct but c and d are wrong
(D) a is correct while b, c and d are wrong

Q.75 The best arrangement of an energy system consisting of hawks, mice snakes and grasses is -
(A) Grass → mice → snake → hawk
(B) Grass → snake → hawk → snake
(C) Grass → mice → hawk → snake
(D) Mice → snake → hawk → grass

Q.76 Which of the following is the first step of glycolysis -
(A) Breakdown of glucose
(B) Phosphorylation of glucose
(C) Conversion of glucose into fructose
(D) Dehydrogenation of glucose

Q.77 The southern blot technique is used for the detection of -
(A) DNA (B) RNA
(C) Protein (D) Cellulose

Q.78 Correct sequence of cell stages in spermatogenesis is -
(A) spermatocytes, spermatids, spermatogonia, spermatozoa
(B) spermatogonia, spermatocytes, spermatids, spermatozoa
(C) spermatocytes, spermatogonia, spermatids, spermatozoa
(D) spermatogonia, spermatids , spermatocytes, spermatozoa

Q.79 What would be the cardiac output of a person having 72 heart beats per minute and stroke volume of 50 ml ?
(A) 360 mL (B) 3600 mL
(C) 7200 mL (D) 5000 mL

Q.80 In the process of recombinant DNA technology, the isolated foreign DNA is inserted into another DNA molecule known as -
(A) DNA vector (B) RNA vector
(C) Protein vector (D) Cloning vector

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 The reflection of the point $P(1, 0, 0)$ in the line $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$ is -
(A) (3, –4, –2) (B) (5, –8, –4)
(C) (1, –1, –10) (D) (2, –3, 8)

Q.82 The range of 'α' for which the point (α, α) lies inside the region bounded by the curves $y = \sqrt{1-x^2}$ and $x + y = 1$ is -
(A) $\frac{1}{2} < \alpha < \frac{1}{\sqrt{2}}$ (B) $-\frac{1}{\sqrt{2}} < \alpha < \frac{1}{\sqrt{2}}$
(C) $\alpha > \frac{1}{2}$ (D) $0 < \alpha < \frac{1}{2}$

Q.83 The solution of the differential equation $x^2 \frac{dy}{dx} \cdot \cos\left(\frac{1}{x}\right) - y \sin\left(\frac{1}{x}\right) = -1$.
Where $y \to -1$ as $x \to \infty$ is -
(A) $y = \sin\frac{1}{x} + \cos\frac{1}{x}$
(B) $y = \frac{x+1}{x\sin(1/x)}$
(C) $y = \sin\frac{1}{x} - \cos\frac{1}{x}$
(D) $y = \frac{x+1}{x\cos(1/x)}$

Q.84 If $\cot^{-1} 7 + \cot^{-1} 8 + \cot^{-1} 18 = \theta$, then $\cot\theta$ is equal to -
(A) $\frac{1}{13}$ (B) 3 (C) $\frac{1}{2}$ (D) 2

Q.85 If B is adjoint of A which is $n \times n$ matrix, then $|AB + KI_n| =$
(A) $|A| + K$ (B) $|A| + K^n$
(C) $(|A| + K)^n$ (D) none of these

Q.86 A variable chord PQ of parabola $y^2 = 4ax$ subtends a right angle at the vertex. Find the locus of point of intersection of the tangents at P and Q.
(A) 0 (B) 1 (C) 2 (D) none

Q.87 The medians of a ΔABC are 9 cm, 12 cm and 15 cm respectively. Then the area of the triangle is -
(A) 96 sq. cm (B) 84 sq. cm
(C) 72 sq. cm (D) 60 sq. cm

Q.88 If the straight line $x = y\sqrt{3}$ cuts the ellipse $x^2 + y^2 + xy = 3$ at points P and Q, then $|OP|\ |OQ|$ is (where 'O' is the origin)

(A) $4+\sqrt{3}$ (B) $\frac{12}{4-\sqrt{3}}$

(C) $\frac{12}{4+\sqrt{3}}$ (D) $\frac{-12}{4+\sqrt{3}}$

Q.89 The angle at which the curve $y = ke^{kx}$ intersects the y-axis is -

(A) $\tan^{-1} k^2$ (B) $\cot^{-1}(k^2)$

(C) $2\sin^{-1}\left(\frac{1}{\sqrt{1+k^4}}\right)$ (D) $\sec^{-1}(\sqrt{1+k^4})$

Q.90 The general solution of the equation $\tan 3x = \tan 5x$ is -

(A) $x = \frac{n\pi}{2}, n \in Z$

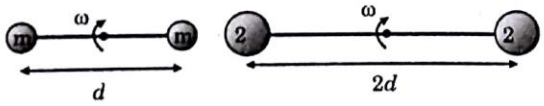
(B) $x = n\pi, n \in Z$

(C) $x = (2n+1)\pi, n \in Z$

(D) none of these

PHYSICS

Q.91 A dumbbell consists of two masses m connected by a rigid rod of negligible mass and length d. A physics student takes the dumbbell and rotates it about its center of mass with an angular velocity ω, giving it an angular momentum L_1. The student then takes a second dumbbell, with masses 2m and length 2d, and rotates them with the same angular velocity ω. What is the angular momentum L_2 of this second dumbbell?



(A) $2L_1$ (B) $4L_1$

(C) $6L_1$ (D) $8L_1$

Q.92 In Young's double slit experiment, the introduction of a thin transparent film reduces the intensity at centre of screen by 75%. Then (μ = refractive index of film, t = thickness of film and λ = wavelength of light used)

(A) $\mu = \frac{5}{2}$ if $\lambda = 2t$

(B) $\mu = \frac{5}{3}$ if $\lambda = t$

(C) $\mu = \frac{5}{3}$ if $\lambda = 3t$

(D) $\mu = \frac{4}{3}$ for any value of λ

Q.93 A certain mass of gas undergoes a process given by $dU = \frac{dW}{2}$. If the molar heat capacity of the gas for this process is $\frac{15}{2}R$, then the gas is :

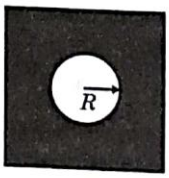
(A) monoatomic

(B) polyatomic

(C) diatomic

(D) data insufficient

Q.94 There is rectangular wire frame having a thin film of soap solution. A massless thin wire of radius R and area of cross section A is placed on the surface of film and inside portion of the film is pricked. If surface tension of soap solution is S and Young's modulus of wire is Y then change in radius of the wire is :



(A) $\frac{SR^2}{AY}$ (B) $\frac{2SR^2}{AY}$

(C) $\frac{SR^2}{3AY}$ (D) none of these

Q.95 Two coils have self-inductances $L_1 = 8$ mH and $L_2 = 2$ mH. In both of them currents are increased at the same constant rate. At a certain instant the power given to the two coils is the same. If at that instant, i_1, V_1, U_1 and i_2, V_2, U_2 be the currents, induced voltages and energies stored in the two coils respectively, then –

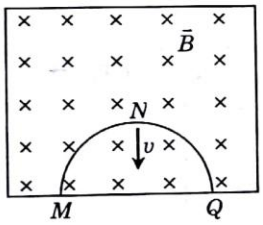
(a) $i_1/i_2 = 1/4$ (b) $i_1/i_2 = 4$

(c) $U_2/U_1 = 4$ (d) $V_2/V_1 = 1/4$

(A) a, b, c (B) a, b, d

(C) a, c, d (D) b, c, d

Q.96 A thin semi-circular conducting ring of radius R is falling its plane vertical in a horizontal magnetic induction $\bar{B}$. At the position MNQ the speed of the ring is v and potential difference developed across the ring is –



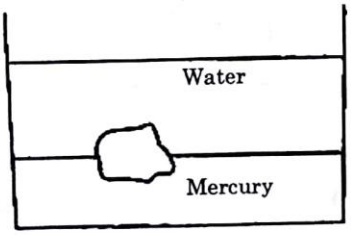
(A) zero

(B) B v $\pi R^2/2$ and M is at higher potential

(C) π R B v and Q is at higher potential

(D) 2 R B v and Q is at higher potential

Q.97 A piece of granite floats at the interface of mercury and water contained in a beaker (Fig.). If the densities of granite, water and mercury are ρ, ρ_1 and ρ_2 respectively, the ratio of the volume of granite in water to the volume in mercury is –



(A) $(\rho_2 - \rho)/(\rho - \rho_1)$

(B) $(\rho_2 + \rho)/(\rho + \rho_1)$

(C) $\rho_1\rho_2/\rho$

(D) ρ_1/ρ_2

Q.98 A simple pendulum is constructed by attaching a mass m to a thin rod of length ℓ. The pendulum is pulled back to some angle $\theta > 30°$ from the vertical and released. Which of the following techniques could be used to change the frequency f of this pendulum ?

I. Changing the mass m on the end of the pnedulum

II. Changing the length ℓ for the pendulum

III. Changing the angle θ from which the pendulum is released

(A) I only (B) I and II only

(C) II only (D) II and III only

Q.99 Two identical trucks each of mass M (excluding sacks of rice) move on national highways with speeds v_1 and v_2 towards each other. When they meet each other, a sack of rice of mass m is thrown from one track to the other and an identical sack of rice is thrown from the second to the first. Calculate their velocities v_1' and v_2' after the exchange of sacks, given m = 50 kg, $M = 200$ kg, $\left|\vec{v}_1\right| = 50$ m/s and $\left|\vec{v}_2\right| = 200$ m/s.

Friction of the road may be neglected –

(A) 0, – 150 m/s

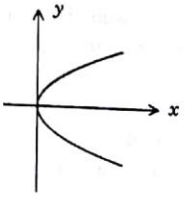
(B) 150 m/s, – 50 m/s

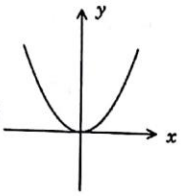
(C) 100 m/s, 150 m/s

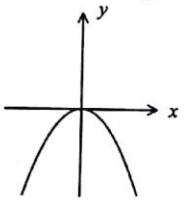
(D) 100 m/s, 50 m/s

Q.100 A particle moves in the x-y plane with velocity $\vec{v} = a\hat{i} + bx\hat{j}$, where a and b are constants. Initially, the particle was at the origin. The trajectory of the particle is –

(A) 

(B) 

(C) 

(D) 

CHEMISTRY

Q.101 Which of the following statement is correct ?

(A) S–S bond is present in $H_2S_2O_6$.

(B) In peroxosulphuric acid (H_2SO_5) sulphur is in + 8 oxidation state.

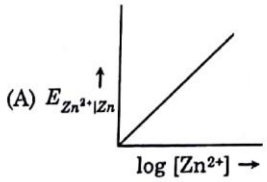
(C) Copper powder along with Al_2O_3 and K_2O is used as a catalyst in the preparation of NH_3 by Haber's process.

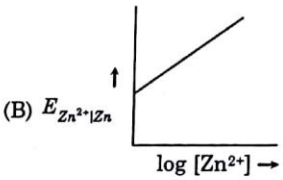
(D) Change in enthalpy is positive for the preparation of SO_3 by catalytic oxidation of SO_2.

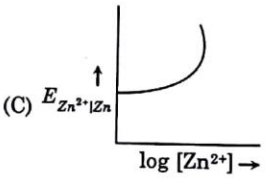
Q.102 Electrode potential for Zn electrode varies according to the equation.

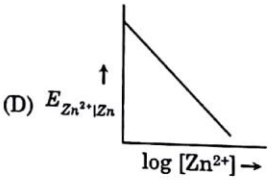
$$E_{Zn^{2+}|Zn} = E^{o}_{Zn^{2+}|Zn} - \frac{0.059}{2} \log \frac{1}{[Zn^{2+}]}.$$

The graph of $E_{Zn^{2+}|Zn}$ vs $log\ [Zn^{2+}]$ is -

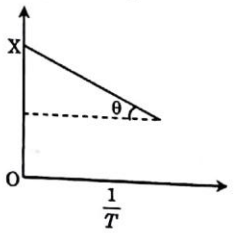
(A) 

(B) 

(C) 

(D) 

Q.103 Graph between log K and $\frac{1}{T}$ [Where K is rate constant (S^{-1}) and T is temperature (K)] is a straight line with OX = 5, $\theta = \tan^{-1}\left[-\frac{1}{2.303}\right]$.

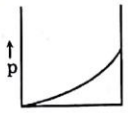


Hence E_a and log A respectively will be :

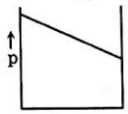
(A) 2.303 × 2 cal, 5 (B) $\frac{2}{3.303}$ cal, e^5

(C) 2 cal, 5 (D) none of these

Q.104 For a binary ideal liquid solution, the variation in total vapour pressure versus composition of solution is given by which of the curves ?

(A) 

(B) 

(C) 

(D) (B) & (C)

Q.105 (I) $[MnCl_6]^{3-}$, $[FeF_5]^{3-}$ and $[CoF_5]^{3-}$ are paramagnetic having four, five and four unpaired electrons respectively.

(II) Valence bond theory gives a quantitative interpretation of the thermodynamics stabilities of coordination compounds.

(III) The crystal field splitting Δ_o, depends upon the field produced by the ligand and charge on the metal ion.

Amongs the following correct statements are -

(A) I, II (B) I, III

(C) I, II, III (D) II, III

Q.106 1 mol CH_3COOH is added in 250 g benzene Acetic acid dimerises in benzene due to hydrogen bond. K_b of benzene is 2K $kgmol^{-1}$. The boiling point has increased by 6.4 K. % dimerisation of acetic acid is -

(A) 50 (B) 40 (C) 30 (D) 20

Q.107 S_1 : *Trans*-But-2-ene has higher boiling point than *cis*-But-2-ene.

S_2 : 1,4-dichlorobenzene has zero dipole moment.

S_3 : *Trans* cyclodecene is more stable as compare to *cis*-cylodecene.

S_4 : *Trans* 1, 2-Dibromoethene is more soluble in water than *cis*-1, 2-Dibromoethene.

(A) T T T T (B) F T F T

(C) F F F F (D) F T F F

Q.108 Compound $X(C_3H_6O)$ gives negative tests with the following reagents.

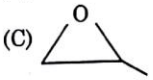
(a) Br_2

(b) 2, 4-Dinitrophenylhydrazine

(c) Na metal.

It gives two monochloro structural isomers. Identify 'X'.

(A) $CH_2=CH-O-CH_3$ (B) CH_3-CH_2-CHO

(C) 

(D) 

Q.109 Two hexoses form the same osazone find the correct statement about these hexoses.

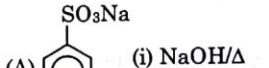
(A) Both of them must be aldoses

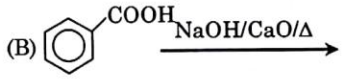
(B) They are epimers at C-3

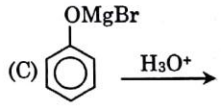
(C) The carbon atoms 1 and 2 in both have the same configuration

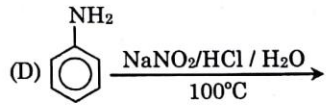
(D) The carbon atoms 3, 4 and 5 in both have the same configuration

Q.110 Phenol is not obtained by -

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.111 If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from-

(A) Vagina to uterus

(B) testes to epididymis

(C) epididymis to vas deferens

(D) ovary to uterus

Q.112 What is blood pressure-
(A) The pressure of blood on the heart muscle
(B) The pressure of blood exerted on the walls of arteries and veins
(C) The pressure of blood on the walls of veins only
(D) The pressure of blood on the walls of arteries only

Q.113 Fill up the blanks –
I. The primary lymphoid organs are ___ and ___.
II. Heroin commonly called "smack" is chemically____.
III. _____ tumors remain confined to their original location and do not spread to other parts of the body.
IV. The immune system comprises _____ cells and _____ cells
(A) I-bone marrow & thymus;
II-diacetylmorphine;
III-benign;
IV-B, T
(B) I-bone marrow & thymus;
II-diacetylmorphine;
III-malignant
IV-B, T
(C) I-bone marrow & thymus;
II-benzodiazepenes;
III-benign;
IV-B,T
(D) I-M.A.L.T.;
II-diacetylmorphine;
III-benign;
IV-B,T

Q.114 The type of immunoglobulin, whose function is possible antigen recognition by B-cells, may be -
(A) IgE (B) IgA (C) IgD (D) IgG

Q.115 Hyaluronic acid is present in -
(A) Human sperm
(B) Ovary
(C) Ovum covering of the female
(D) A type of protein of blood

Q.116 This is a method of birthcontrol -
(A) IUDs (B) GIFT
(C) HTF (D) IVF-ET

Q.117 Evolution of heart from one to two, three and four chambered proves :
(A) Biogenetic law of Haeckel
(B) Lamarckism
(C) Hardy weinberg's law
(D) Neo Darwinism

Q.118 Homologous organs are :
(A) Wings of cockroach and wings of bats
(B) Wings of insects and wings of birds
(C) Air bladder of fishes and lungs of frog
(D) Pectoral fins of fishes and forelimbs of horse

Q.119 Ranikhet disease is associated with -
(A) Fishes (B) Hens
(C) Pigs (D) Honeybees

Q.120 Match the revolutions given under Column I with their respective fields given under Column-II; choose the answer which gives correct combination of alphabets of two columns -

Column-I	Column-II
(A) White revolution	(p) Diary
(B) Blue revolution	(q) Agriculture
(C) Green revolution	(r) Fisheries

(A) A → p; B → r; C → q
(B) A → r; B → q; C → p
(C) A → q; B → p; C → r
(D) A → p; B → r; C → q

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-3

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 From an external point P, pair of tangent lines are drawn to the parabola $y^2 = 4x$. If θ_1 and θ_2 be the inclinations of these tangents with the axis of x such that $\theta_1 + \theta_2 = \frac{\pi}{4}$, then the locus of P is –

(A) $x - y + 1 = 0$

(B) $x + y - 1 = 0$

(C) $x - y - 1 = 0$

(D) $x + y + 1 = 0$

Q.2 If $A(1 + i)$, $B(3 + 4i)$ and $C(z)$ are the vertices of a ΔABC in which $\angle BAC = \frac{\pi}{3}$ and $AC = 2AB$.

Then z is-

(A) $3 + 4i + i\sqrt{3}\,(2 + 3i)$

(B) $(3 + 4i) + \frac{1}{\sqrt{3}}\,i(2 + 3i)$

(C) $(2 + 3i) + i\sqrt{3}\,(3 + 4i)$

(D) $(2 + 3i) + \frac{i}{\sqrt{3}}\,(3 + 4i)$

Q.3 If $\overline{X}_1$ and $\overline{X}_2$ are the means of two distributions such that $\overline{X}_1 < \overline{X}_2$ and $\overline{X}$ is the mean of the combined distribution, then

(A) $\overline{X} < \overline{X}_1$ (B) $\overline{X} > \overline{X}_2$

(C) $\overline{X} = \frac{\overline{X}_1 + \overline{X}_2}{2}$ (D) $\overline{X}_1 < \overline{X} < \overline{X}_2$

Q.4 Let A, B, C be three events in a probability space. Suppose that $P(A) = 0.5$, $P(B) = 0.3$, $P(C) = 0.2$, $P(A \cap B) = 0.15$, $P(A \cap C) = 0.1$ and $P(B \cap C) = 0.06$, the greatest possible value of $P(A^c \cap B^c \cap C^c)$ is [Note : A^c denotes compliment of event A]

(A) 0.31 (B) 0.25 (C) 0 (D) 0.26

Q.5 The interval in which function $f(x) = \sin^{-1}(x^2 - 3x + 3)$ is increasing, is-

(A) [1, 2] (B) $\left[\frac{3}{2}, \infty\right)$

(C) $\left[\frac{3}{2}, 2\right]$ (D) None of these

Q.6 What is the function whose graph is the reflection about the line $x + y = 0$ of the inverse function $f^{-1}(x)$ of a function $f(x)$:

(A) $-f(x)$ (B) $-f(-x)$

(C) $-f^{-1}(x)$ (D) $-f^{-1}(-x)$

Q.7 If the chords of contact of tangents from two points (–4, 2) and (2, 1) to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ are at right angle, then the eccentricity of the hyperbola is -

(A) $\frac{\sqrt{7}}{2}$ (B) $\sqrt{\frac{5}{3}}$ (C) $\sqrt{\frac{3}{2}}$ (D) $\sqrt{2}$

Q.8 If $f(x) = 2e^x - c \ln x$ monotonically increases for every $x \in (0, \infty)$, then the true set of values of c is -

(A) $\left(-\infty, \frac{1}{e}\right)$ (B) $\left(-\infty, \frac{2}{e}\right)$

(C) $[0, \infty)$ (D) $(-\infty, 0]$

Q.9 If $a, b, c, d \in R$ such that $\frac{a + 2c}{b + 3d} + \frac{4}{3} = 0$, then the equation $ax^3 + bx^2 + cx + d = 0$ has -

(A) at least one root in (–1, 0)

(B) at least one root in (0, 1)

(C) no root in (–1, 1)

(D) no root in (0, 2)

Q.10 Let α and β be the solutions of the quadratic equation $x^2 - 1154x + 1 = 0$, then the value of $\sqrt[4]{\alpha} + \sqrt[4]{\beta}$ is equal to -

(A) 4 (B) 5 (C) 6 (D) 8

Q.11 A and B are square matrices and A is non-singular matrix, $(A^{-1}BA)^n$, $n \in I^+$, is equal to -

(A) $A^{-n}B^nA^n$ (B) $A^nB^nA^{-n}$

(C) $A^{-1}B^nA$ (D) $A^{-n}BA^n$

Q.12 A point Q is selected at random inside the equilateral triangle. If sum of lengths of perpendicular dropped on sides from Q is P, then length of altitude of Δ is-

(A) $\frac{P}{2}$ (B) $\frac{P}{3}$

(C) P (D) None of these

Q.13 If $x, y, z \in R^+$ such that :

$x^2 + 9y^2 + 25z^2 = xyz\left(\frac{15}{x} + \frac{5}{y} + \frac{3}{z}\right)$. Then x, y, z are in-

(A) A.P. (B) G.P.

(C) H.P. (D) None of these

Q.14 If $\vec{a}$ & $\vec{b}$ are any two vectors of magnitudes 1 and 2 respectively, and $(1 - 3\vec{a}.\vec{b})^2 + |2\vec{a} + \vec{b} + 3(\vec{a} \times \vec{b})|^2 = 47$, then the angle between $\vec{a}$ and $\vec{b}$ is -

(A) $\frac{\pi}{3}$ (B) $\pi - \cos^{-1}\left(\frac{1}{4}\right)$

(C) $\frac{2\pi}{3}$ (D) $\cos^{-1}\left(\frac{1}{4}\right)$

Q.15 Let $\{a_n\}$ $(n \geq 1)$ be a sequence such that $a_1 = 1$, and $3a_{n+1} - 3a_n = 1$ for all $n \geq 1$. Then a_{2002} is equal to-

(A) 666 (B) 667

(C) 668 (D) 669

Q.16 The solution of the in-equation $4^{-x+0.5} - 7.2^{-x} < 4$, $x \in R$, is :

(A) $(-2, \infty)$ (B) $(2, \infty)$

(C) $\left(2, \frac{7}{2}\right)$ (D) None of these

Q.17 If $x + y + z = 12$ & $x^2 + y^2 + z^2 = 96$ & $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 36$ then value of $x^3 + y^3 + z^3$ is

(A) 862 (B) 863 (C) 865 (D) 866

Q.18 The number of values of k for which $[x^2 - (k-2)x + k^2][x^2 + kx + (2k-1)]$ is a perfect square is -

(A) 1 (B) 2

(C) 0 (D) none of these

Q.19 Number of irrational terms in expansion of $(\sqrt{3}+\sqrt{7})^{17}$ is equal to $3k + k^2$ then k equals

(A) 7 (B) 3 (C) 5 (D) None

Q.20 For the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$, which one of the following is incorrect ?

(A) it lies in the plane $x - 2y + z = 0$

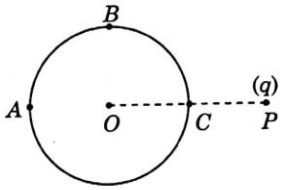
(B) it is same as line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$

(C) it passes through (2, 3, 5)

(D) it is parallel to the plane $x - 2y + z - 6 = 0$

PHYSICS

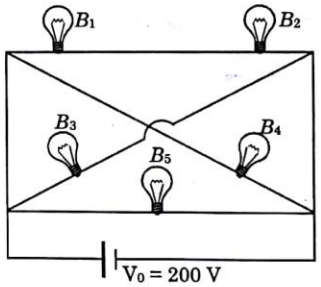
Q.21 A hollow conducting sphere is placed in an electric field produced by a point charge as shown. Let V_A, V_B, V_C be the electric potentials at points A, B, C respectively and V_0 is the potential at centre O due to induced charge on shell -



(A) $V_0 = 0$ (B) $V_A > V_B > V_C$

(C) $V_A = V_0 \neq V_C$ (D) $V_A < V_B < V_C$

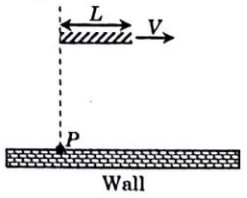
Q.22 Five bulbs B_1, B_2, B_3 and B_4 each of rating 60 W / 200 V and B_5 of rating 120 W / 400 V are connected as shown in circuit. Total power consumption by all the bulbs is -



(A) 240 W (B) 270 W

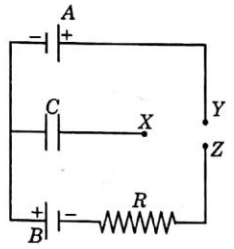
(C) 90 W (D) 180 W

Q.23 The mirror of length L moves horizontally as shown in the figure with a velocity v. The mirror is illuminated by a point source of light 'P' placed on the ground. The rate at which the length of the light spot on the ground increases is -



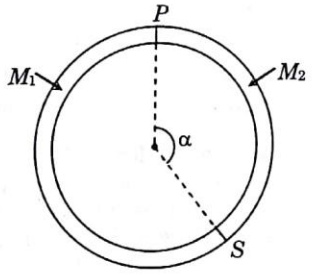
(A) v (B) zero (C) 2v (D) 3v

Q.24 In the circuit shown the cells are ideal & of equal e.m.f., the capacitance of the capacitor is C and the resistance of the resistor is R. X is first joined to Y and then to Z. After a long time the total heat produced in the resistor will be -



(A) equal to the energy finally stored in the capacitor
(B) half of the energy finally stored in the capacitor
(C) twice the energy finally stored in the capacitor
(D) 4 times the energy finally stored in the capacitor

Q.25 A ring shaped tube contains two ideal gases with equal masses and atomic mass numbers $M_1 = 32$ and $M_2 = 28$. The gases are separated by one fixed partition P and another movable conducting partition S which can move freely without friction inside the ring. The angle α as shown in the figure in equilibrium is -



(A) $\frac{7\pi}{8}$ (B) $\frac{8\pi}{7}$ (C) $\frac{15\pi}{16}$ (D) $\frac{16\pi}{15}$

Q.26 The wave-function for a certain standing wave on a string fixed at both ends is $y(x, t) = 0.5 \sin(0.025\,\pi x) \cos 500\,t$ where x and y are in centimeters and t is in seconds. The shortest possible length of the string is -

(A) 126 cm (B) 160 cm
(C) 40 cm (D) 80 cm

Q.27 Consider three statements :

1. In photo electric effect, even for monochromatic incident radiation, the photoelectrons are emitter with a spread of velocities.
2. Photoelectrons are emitted without delay once the incident light reaches the surface of the emitter.
3. Frequency of monochromatic light (well above the cutoff frequency), that is incident on a emitter in a photoelectric effect, is increased while keeping the intensity constant. It results in decrease in magnitude of stopping potential.

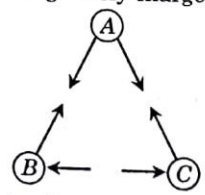
Correct order of the true/false for the above statements is -

(A) TTF (B) FTT
(C) TFT (D) FFT

Q.28 An element X decays, first by positron emission and then two α-particles are emitted in successive radioactive decay. If the product nuclei has a mass number 229 and atomic number 89, the mass number and atomic number of element X are -

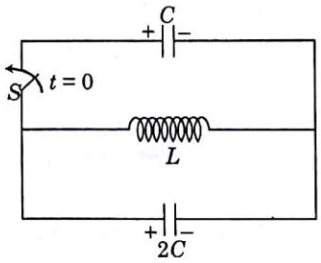
(A) 237, 93 (B) 237, 94
(C) 221, 84 (D) 237, 92

Q.29 The diagram shows the arrangement of three small uniformly charged spheres A, B and C. The arrows indicate the direction of the electrostatic forces acting between the spheres (for example, the left arrow on sphere A indicates the electrostatic force on sphere A due to sphere B). At least two of the spheres are positively charged. Which sphere, if any, could be negatively charged ?



(A) sphere A (B) sphere B
(C) sphere C (D) no sphere

Q.30 In the given LC circuit if initially capacitor C has charge Q on it and $2C$ has charge $2Q$. Then after closing switch S at $t = 0$.



(A) energy will get equally distributed in both the capacitor

(B) initial rate of growth of current in indicator will be $2Q/3CL$

(C) maximum energy in the inductor will be $3Q^2/2C$

(D) none of these

Q.31 The path difference between two interfering waves at a point on the screen is $\lambda/6$. The ratio of intensity at this point and that at the central bright fringe will be – (Assume that intensity due to each slit in same)

(A) 0.853 (B) 8.53

(C) 0.75 (D) 7.5

Q.32 The wavefront of a light beam is given by the equation $x + 2y + 3z = c$, (where c is arbitrary constant) then the angle made by the direction of light with the y-axis is -

(A) $\cos^{-1}\frac{1}{\sqrt{14}}$ (B) $\sin^{-1}\frac{2}{\sqrt{14}}$

(C) $\cos^{-1}\frac{2}{\sqrt{14}}$ (D) $\sin^{-1}\frac{3}{\sqrt{14}}$

Q.33 A charged particle moves in a uniform magnetic field but constant with time such that initial velocity is perpendicular to the magnetic field. If no other force acts on the particle, then -

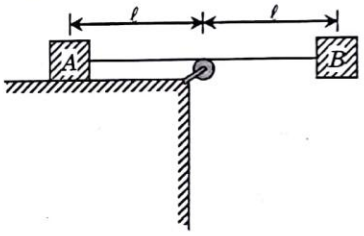
(A) the motion is uniform rectilinear

(B) the motion can be non-uniform circular motion

(C) the motion can be uniform circular motion

(D) the motion must be uniform circular motion

Q.34 Two blocks A and B of same mass are attached by a thin inextensible string through an ideal pulley. Initially block B is held in position as shown in figure. Now the block B is released. Block A will slide to right angle hit the pulley in time t_A. Block B will swing and hit the surface in time t_B. Assume the surface as frictionless.



(A) $t_A = t_B$

(B) $t_A < t_B$

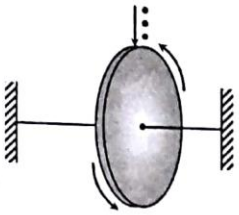
(C) $t_A > t_B$

(D) data are not sufficient to get relationship between t_A and t_B

Q.35 A sample contains number of stable nuclei equal to N_s and number of unstable nuclei equal to N_u. After a time T the activity of the sample decreased to one third of the initial activity, while the total number of nuclei (excluding decayed nuclei) became half. The ratio N_s/N_u initially is -

(A) 1/3 (B) 1/4 (C) 3 (D) 2

Q.36 Suppose in gravity free space a disc of mass m_0 rotates freely about a fixed horizontal axis through its centre. A thin cotton pad is fixed to its rim, which can absorb water. The mass of water dripping onto the pad is μ kg per second. After what time will the angular velocity of the disc get reduced to half of its initial value ?

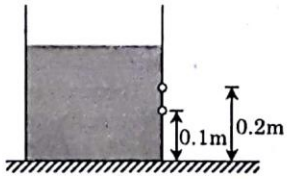


(A) $2m_0/\mu$ (B) $3m_0/\mu$
(C) m_0/μ (D) $m_0/2\mu$

Q.37 The surface tension and bulk modulus of elasticity of water are S and B respectively. Then the ratio $\frac{B}{S}$ is dimensionally equivalent to the dimension of -
(A) Length
(B) Wave number
(C) (area)$^{-1}$
(D) Force

Q.38 A uniform metal rod (fixed at both ends) of 2 mm^2 cross-section is cooled from 40°C to 20°C. The co-efficient of the linear expansion of the rod is 12×10^{-4} per degree & It's young modulus of elasticity is 10^{11} N/m^2. The energy stored per unit volume of the rod is -
(A) 2880 J/m^3 (B) 1500 J/m^3
(C) 5760 J/m^3 (D) 1440 J/m^3

Q.39 A long cylindrical drum is filled with water. Two small holes are made on the side of the drum as shown in the figure. Find the depth of the liquid in the drum if the ranges of water from the holes are equal -



(A) 0.3 m (B) 0.5 m
(C) 0.7 m (D) 0.9 m

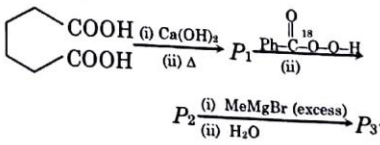
Q.40 Diameter of a planoconvex lens of focal length 37 cm is 6 cm. It's thickness at the centre is 5 mm. The speed of light in the material of the lens is -
(A) 10^8 m/s (B) 2.4×10^8 m/s
(C) 12×10^8 m/s (D) 3×10^8 m/s

CHEMISTRY

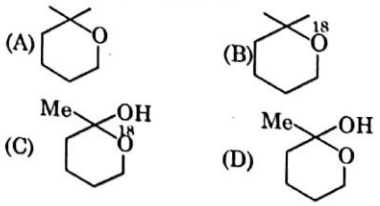
Q.41 Which are true statements among the following?
(A) I_3^+ has bent structure
(B) XeF_2 and CO_2 has same shape
(C) SF_4 is sea-saw structure whereas ICl_3 is T-shaped
(D) All of these

Q.42 Cellulose is a straight chain polysaccharide composed of -
(A) D-glucose units joined by α-glycosidic linkage
(B) D-glucose units joined by β-glycosidic linkage
(C) D-galactose units joined by α-glycosidic linkage
(D) D-galactose units joined by β-glycosidic linkage

Q.43



(Cyclic compound) P_4 is -



Q.44 Which of the following statement(s) is/are false -

(A) p–chloro phenol is more acidic than p-flouro phenol

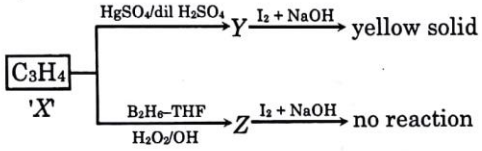
(B) $-\overset{\oplus}{N}Me_3$ is stronger –I group than $-\overset{\oplus}{N}H_3$

(C) Acidity order : o-nitrobenzoic acid > p-nitrobenzoic acid > m-nitrobenzoic acid

(D) Acidity order :

$$H_3C-COOH < H_3Si-\overset{O}{\overset{\|}{C}}-OH$$

Q.45



(A) X is $CH_3-C\equiv C-H$

(B) Y is $CH_3-\overset{O}{\overset{\|}{C}}-C_2H_5$

(C) Z is $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

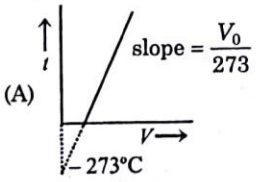
(D) Y is CH_3-CH_2-CHO

Q.46 The two particles A and B have de-Broglie wavelengths 2 nm and 5 nm respectively. If mass of A is twice the mass of B, the ratio of kinetic energies of A and B would be -

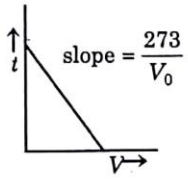
(A) 5 : 1 (B) 25 : 4 (C) 20 : 1 (D) 5 : 4

Q.47 As per Charles law the plot of centigrade temperature (t) against the volume of gas at definite pressure for the definite mass of gas is -

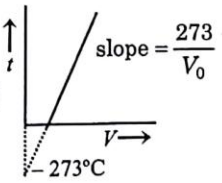
(A)



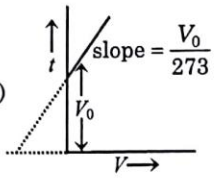
(B)



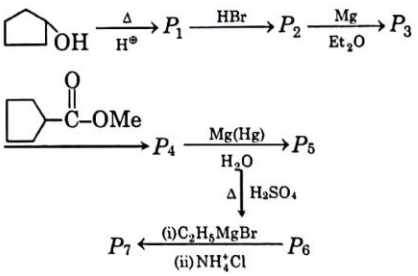
(C)



(D)



Q.48



What is the total number of carbon atoms is in P_1 to P_7 products.

(A) 91 (B) 92 (C) 93 (D) 94

Q.49 Which of the following coordination compound is incapable of showing geometrical isomerism ?

(A) $[PtCl_2(NH_3)_2]$

(B) $[CoCl_2(NH_3)_4]^+$

(C) $[Co(NO_2)_3(NH_3)_3]$

(D) $[Co(en)_3]^{3+}$

Q.50 For a general n^{th} order process $A \rightarrow P$ with initial concentration of reactant "a" and rate constant k, the expression for time for 75% completion of reaction is -

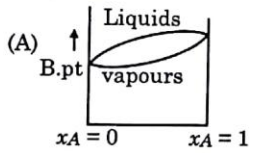
(A) $\frac{1}{n-1}\left(\frac{2^{n-1}-2}{a^{n-1}}\right)\frac{1}{k}$

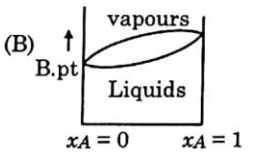
(B) $\frac{1}{n-1}\left(\frac{2^{2n-2}-2}{a^{n-1}}\right)\frac{1}{k}$

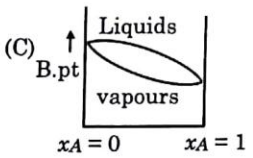
(C) $\frac{1}{n-1}\left(\frac{2^{2n-2}-1}{a^{n-1}}\right)\frac{1}{k}$

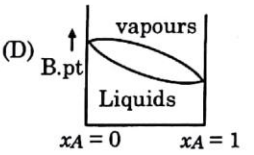
(D) $\frac{1}{n-2}\left(\frac{2^{2n-2}-1}{a^{2n-1}}\right)\frac{1}{k}$

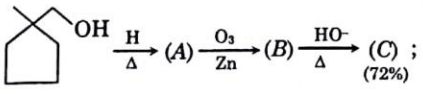
Q.51 Liquids and vapours curves show the compositions of the solution and vapour in equilibrium at the boiling point of the former. Pick out the correct diagram of the following representing the variation of boiling point of solution of two liquid A and B (where A is more volatile) with composition

(A) 

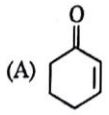
(B) 

(C) 

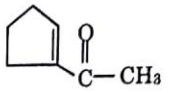
(D) 

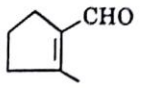
Q.52 

Product (*C*) is :

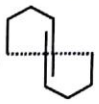
(A) 

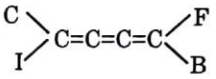
(B) 

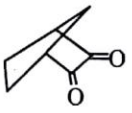
(C) 

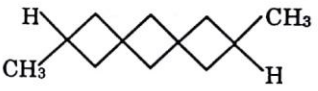
(D) 

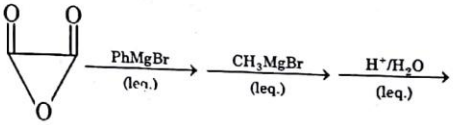
Q.53 Which of the following is optically active –

(A) 

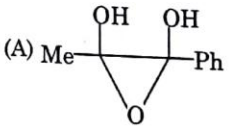
(B) 

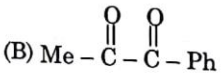
(C) 

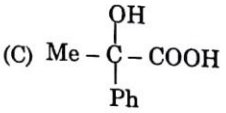
(D) 

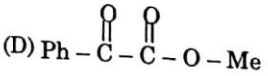
Q.54 

Product is:

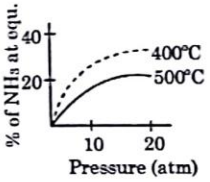
(A) 

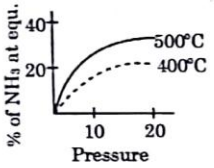
(B) 

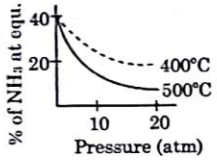
(C) 

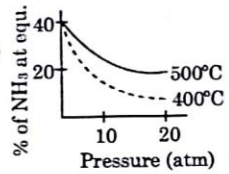
(D) 

Q.55 The percentage of ammonia obtainable, if equilibrium were to be established during the Haber process, is plotted against the operating pressure for two temperatures, 400°C and 500°C. Which of the following graph correctly represent the two process ?

(A) 

(B) 

(C) 

(D) 

Q.56 The gold numbers of protective colloids *A*, *B*, *C* and *D* are 0.16, 0.06, 0.01 and 0.1 respectively. The protective powers of *A*, *B*, *C* and *D* are in the order -

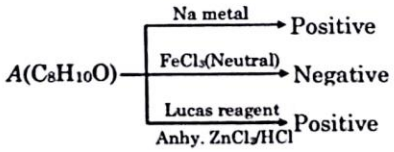
(A) $A > B > C > D$

(B) $C > B > D > A$

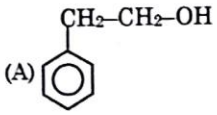
(C) $D > C > A > B$

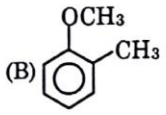
(D) $D > C > B > A$

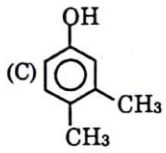
Q.57 An aromatic compound $A(C_8H_{10}O)$ gives following tests with the given reagents.

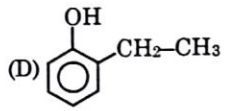


Identify '*A*'

(A) 

(B) 

(C) 

(D) 

Q.58 The specific conductance of a 0.1 N KCl solution at 23°C is 0.0112 $ohm^{-1}\ cm^{-1}$. The resistance of the cell containing the solution at the same temperature was found to be 55 ohm. The cell constant will be :

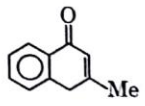
(A) 0.142 cm^{-1}

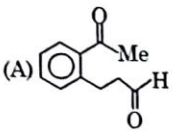
(B) 0.918 cm^{-1}

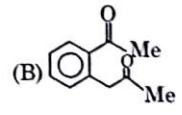
(C) 1.12 cm^{-1}

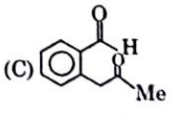
(D) 0.616 cm^{-1}

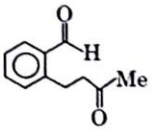
Q.59 Following product is formed in the aldol condensation reaction so identify starting compound.



(A) 

(B) 

(C) 

(D) 

Q.60 What is correct for stability order- of isomers

(I) Cyclohexan 1, 3 diol aa > ee conformer conformer

(II) Cylco octene cis > trans isomer Isomers

(III) 1, 2 dimethyl cyclobutane trans > cis isomer Isomer

(IV) Ethan-1, 2 diol anti form > gauch form

(V) Methyl cyclohexan Axial conformer > equatorial conformer

(A) I, III, IV, V only

(B) I, II, III only

(C) I, III, IV only

(D) All are correct

BIOLOGY

Q.61 Allergens are -

(A) Infectious and increased secretion of IgE

(B) Non-infectious and increased secretions of IgE

(C) Infectious and increased secretion of IgG

(D) Non-infectious and increased secretion of IgM

Q.62 Which disease in children is caused by intensive use of nitrate fertilizer -

(A) Jaundice

(B) Methemoglobinemia

(C) Mumps

(D) Septicemia

Q.63 In snapdragon, when a red flower plant is crossed with a white flower ones, the resultant hybrid plant have pink coloured flower if plant of F_1 generation is crossed with a white flower ones, the progeny will be -

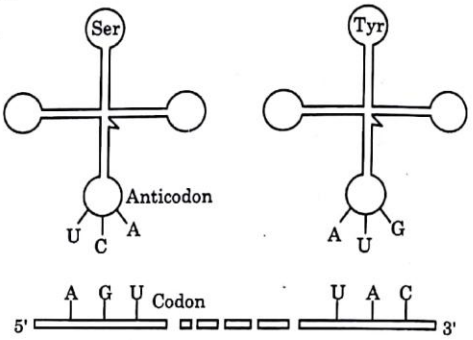
(A) 10 % red

(B) the red flower and white flower ratio in 3 : 1

(C) the pink flower & white flower ratio in 1 : 1

(D) The pink, red and white flower ratio in 1 : 2 : 1

Q.64



The above diagrams of clover leaf life structure of tRNA represent its -

(A) Primary structure

(B) Secondary structure

(C) Tertiary structure

(D) Quaternary structure

Q.65 Due to high degree of polymorphism, size of VNTR varies from -

(A) 0.1 – 2kb (B) 0.1 – 20 kb

(C) 0.01 – 20 kb (D) 0.1 – 200 kb

Q.66 A man takes large amount of protein, He is likely to excrete -

(A) Water

(B) Glucose

(C) Urea and uric acid

(D) Salts

Q.67 Bioassay for auxin is -

(A) Avena curvature test

(B) Green leaf test

(C) Dwarf maize test

(D) Cell division test

Q.68 The hormone involved in metabolism of food material in cereal grain during germination is -

(A) Auxin (B) CK

(C) GA (D) None of these

Q.69 Action of the peptide hormone on a target cell is mediated by -
(A) A cytoplasmic receptor
(B) Cyclic AMP
(C) ATP
(D) Epinephrine

Q.70 Receptors for protein hormones are located -
(A) In cytoplasm
(B) On cell surface
(C) In nucleus
(D) On endoplasmic reticulum

Q.71 If there is deficiency of ADH (antidiuretic hormone). Its effect would be -
(A) The volume of urine will increase
(B) The volume of urine will decrease
(C) The pH of urine will change from 4.8 to 8.0
(D) Secretion of urochrome will take place

Q.72 During photosynthesis -
(A) Both CO_2 and water get oxidized
(B) Both CO_2 and water get reduced
(C) Water is reduced and CO_2 is oxidized
(D) Carbon dioxide get reduced and water get oxidized

Q.73 The number of cranial nerves in rabbit/mammal is -
(A) 10 pairs (B) 12 pairs
(C) 24 pairs (D) 36 pairs

Q.74 The metabolic or energetic phase with most cytogenetic activity is -
(A) Meiosis (B) Interphase
(C) M-Phase (D) Pachytene

Q.75 When breast feeding is replaced by less nutritive food, low in proteins and calories; the infants below the age of one year are likely to suffer from -
(A) Marasmus (B) Rickets
(C) Kwashiorkor (D) Pellagra

Q.76 Which of the following one is correct for a food chain -
(A) Grass-Grasshopper-Frog-Snake-Hawk
(B) Grasshopper-Grass-Snake-Frog-Hawk
(C) Hawk-Grasshopper-Grass-Frog-Snake
(D) Frog-Snake-Hawk-Grasshopper-Grass

Q.77 Each immunoglobin has two heavy chains & two light chains, the antigen binding site is present in -
(A) Variable region of heavy chain
(B) Variable region of both heavy and light chain
(C) Variable region of light chain
(D) Constant region of both light and heavy chain

Q.78 Active immunity is obtained by -
(A) Antibodies
(B) Weakened germs infection
(C) Natural resistance
(D) None of these

Q.79 The disease caused by viruses is -
(A) Tuberculosis (B) Small pox
(C) Chlolera (D) Typhoid

Q.80 In rous sarcoma virus, the flow of information is -
(A) DNA → RNA → Proteins
(B) DNA → Proteins → RNA
(C) RNA → DNA → RNA → proteins
(D) RNA → DNA → proteins

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 Area of the region enclosed between the curves $x = y^2 - 1$ and $x = |y|\sqrt{1-y^2}$ is -
(A) 1 (B) 4/3 (C) 2/3 (D) 2

Q.82 If $ax + by - 5 = 0$ is the equation of the shortest chord of the circle $(x-3)^2 + (y-4)^2 = 4$ passing through the point (2, 3), then $|a+b|$ is -
(A) 2 (B) 4 (C) 1 (D) 8

Q.83 Maximum value of the determinant of order third formed by the elements 0 & 1 only is -

(A) 3 (B) 2

(C) 1 (D) none of these

Q.84 If $f(x) = \int_1^x \frac{xf(x)+1}{x^2}\,dx$ and $f(2) = \frac{3}{4}$, then $f'(1)$ is -

(A) 1 (B) $\frac{1}{2}$ (C) $-\frac{1}{2}$ (D) 0

Q.85 Let $f(x) = \log_{0.5}(x^2 - 5x + 6)$, then $f(x)$ is -

(A) one – one but not onto

(B) one – one and onto

(C) onto but not one – one

(D) neither one – one nor onto

Q.86 If $y = \tan^{-1}\left(\frac{\ell n\frac{e}{x^2}}{\ell n ex^2}\right) + \tan^{-1}\frac{3+2\ell nx}{1-6\ell nx}$ then

$\frac{d^2y}{dx^2} =$

(A) 2 (B) 1 (C) 0 (D) –1

Q.87 If the quadratic equation $f(x) = px^2 - qx + r = 0$ has two distinct roots in (0, 2) where p, q, $r \in N$ and $f(1) = -1$ then the minimum value of p is -

(A) 1 (B) 2

(C) 4 (D) none of these

Q.88 A square, whose side is 2 cm, has its corners cut away so as to form a regular octagon, area of this octagon is -

(A) $8(\sqrt{2}-1)$ (B) $2(\sqrt{2}+1)$

(C) $4(\sqrt{2}+1)$ (D) none of these

Q.89 If the line $y = \sqrt{3}\,x$ intersects the curve $x^3 + y^3 + 3xy + 5x^2 + 4x + 5y - 1 = 0$ at the points A, B, C then $OA \cdot OB \cdot OC$ is (Here 'O' is origin)

(A) $\frac{4}{13}(3\sqrt{3}+1)$

(B) $\frac{4}{13}(3\sqrt{3}-1)$

(C) $\frac{1}{26}(3\sqrt{3}-1)$

(D) $\frac{1}{26}(3\sqrt{3}+1)$

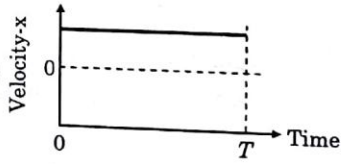
Q.90 The number of roots of the equation, $\sin x + 2\sin 2x = 3 + \sin 3x$ is -

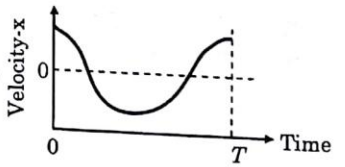
(A) 0 (B) 1

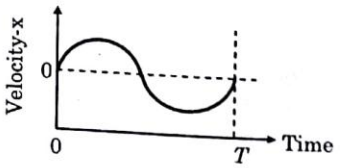
(C) 2 (D) infinite

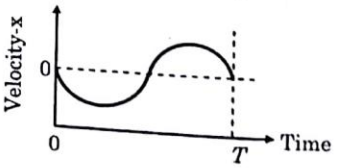
PHYSICS

Q.91 A particle moves constantly in a circle centered at the origin with a period T. If its position at time $t = 0$ seconds is $(A, 0)$ meters, which graph represents v_x, the x-component of the particle's velocity, as a function of time?

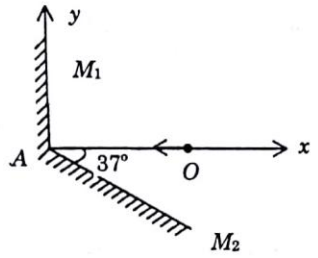
(A)


(B)


(C)


(D)


Q.92 Two plane mirrors are placed as shown in figure. A point object O is approaching the intersection point A of mirrors with a speed of 100 cm/s. The velocity of image of the object formed by M_2 with respect to velocity of image of object formed by M_1 is :



(A) $-128\hat{i}+96\hat{j}\ cm/s$

(B) $-28\hat{i}+48\hat{j}\ cm/s$

(C) $128\hat{i}-48\hat{j}\ cm/s$

(D) $100\hat{i}+48\hat{j}\ cm/s$

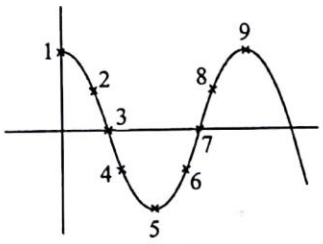
Q.93 A nut is screwed onto a bolt with 12 turns per cm and diameter more than 1 cm. The bolt is lying in a horizontal position. The nut spins at 216 rpm. Time taken by the nut to cover 3 cm along the bolt is :

(A) 10 s (B) 12 s (C) 14 s (D) 16 s

Q.94 A motor bike accelerates from rest at a constant rate of 3 ms^{-2} for some time and then moves with uniform velocity for the same duration. Then it retards at a constant rate of 6 ms^{-2} and comes to rest. The bike was in motion for a period of 5 seconds. The total distance travelled by the bike is :

(A) 21 m (B) 24 m (C) 27 m (D) 30 m

Q.95 Figure shows a sinusoidal wave of period T travelling to the right along a string at time t = 0. Which of the following statement is incorrect?



(A) The point 3 on the string is moving upward with maximum speed

(B) The point 5 on the string has the greatest upward acceleration

(C) The point 9 on the string has the greatest downward acceleration

(D) The point 2 on the string has a downward velocity and upward acceleration

Q.96 What is the minimum number of geostationary satellites required for uninterrupted global coverage?

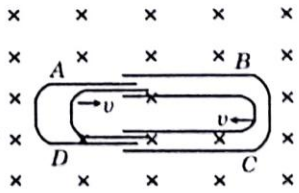
(A) 3 (B) 5 (C) 7 (D) 9

Q.97 For sky wave propagation of 10 MHz signal, what should be the minimum electron density in ionosphere ?

(A) $1.2 \times 10^{12}\ m^{-3}$ (B) $10^{6}\ m^{-3}$

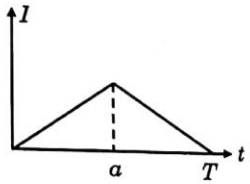
(C) $10^{14}\ m^{-3}$ (D) $10^{22}\ m^{-3}$

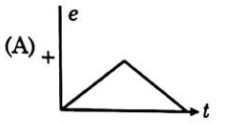
Q.98 One conducting U-tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed v, then the emf induced in the circuit in terms of B, l and v, where l is the width of each tube, will be :

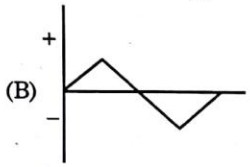


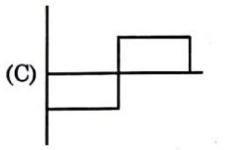
(A) Blv (B) –Blv (C) zero (D) 2Blv

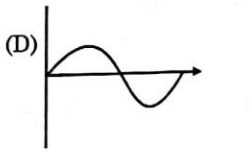
Q.99 The current I in an inductance coil varies with time t according to the graph shown in figure. Which one of the following plots shows the variation of voltage in the coil with time?



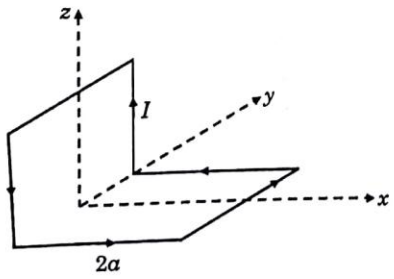
(A) 

(B) 

(C) 

(D) 

Q.100 A non-planar loop of conducting wire carrying a current I is placed as shown in the figure. Each of the straight sections of the loop of length $2a$. The magnetic field due to this loop at the point $P(a, 0, a)$ points in the direction



(A) $\frac{1}{\sqrt{2}}(-\hat{j}+\hat{k})$ (B) $\frac{1}{\sqrt{3}}(-\hat{j}+\hat{k}+\hat{i})$

(C) $\frac{1}{\sqrt{3}}(\hat{i}+\hat{j}+\hat{k})$ (D) $\frac{1}{\sqrt{2}}(\hat{i}+\hat{k})$

CHEMISTRY

Q.101 The decomposition NH_3 gas on a heated tungsten surface gave the following results :

Initial pressure (mm)	65	105	y	185
Hlf-life (sec)	290	x	670	820

Calculate approximately the values of x and y.

(A) $x = 410$ sec (B) $x = 467$ sec

(C) $x = 490$ sec (D) $x = 430$ sec

Q.102 The cell Pt (H_2) (1 atm) | H^+ (pH = ?) | | . (a = 1) | Ag has emf, $E_{298} = 0$. The standard electrode potential for the reaction $AgL + e^- \rightarrow Ag + I^{\ominus}$ is − 0.151 volt. Calculate the pH value -

(A) 3.37 (B) 5.26 (C) 2.56 (D) 4.62

Q.103 Which of the following is / are inner orbital complex (es) as well as diamagnetic in nature ?

(A) $[Zn(NH_3)_6]^{2+}$ (B) $[Ni(NH_3)_6]^{2+}$

(C) $[Cr(NH_3)_6]^{3+}$ (D) $[Co(NH_3)_6]^{3+}$

Q.104 The freezing point of aqueous solution that contains 3 % urea, 7.45 % KCl and 9 % of glucose is (given K_f of water = 1.86 and assume molarity = molarity)

(A) 290 K (B) 285.5 K

(C) 267.42 K (D) 250 K

Q.105 Consider the folownig reactions at 300 K.

$A \rightarrow B$ (uncatalysed reaction)

$A \xrightarrow{catalyst} B$ (catalyst reaction)

The activation energy is lowered by 8.314 kJ mol^{-1} for the catalysed reaction. How many times the rate of this catalysed reaction greater than that of uncatalysed reaction ? (Given $e^{3.33} = 28$)

(A) 15 times (B) 38 times

(C) 22 times (D) 28 times

Q.106 $Cu^+ + e^- \rightarrow Cu$, $E^\circ = x_1$ volt;
$Cu^{2+} + 2e^- \rightarrow Cu$, $E^\circ = x_2$ volt, then for
$Cu^{2+} + e^- \rightarrow Cu^+$, E° (volt) will be -
(A) $x_1 - 2x_2$ (B) $x_1 + 2x_2$
(C) $x_1 - x_2$ (D) $2x_2 - x_1$

Q.107 Match materials given in Column-I with the polymers given in Column-II.

Column-I	Column-II
(1) Ropes and fibres	(a) Nylon
(2) Polyester fabric	(b) Neoprene
(3) Synthetic rubber	(c) Dacron
(4) Unbreakable crockery	(d) Melamine formaldehyde resins

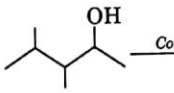
(A) 1-a, 2-c, 3-d, 4-b
(B) 1-c, 2-a, 3-b, 4-d
(C) 1-a, 2-c, 3-b, 4-d
(D) 1-a, 2-b, 3-c, 4-d

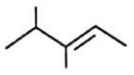
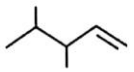
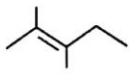
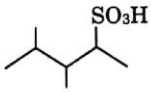
Q.108 Ethylene chloride and ethylidene chloride are isomers. Identify the correct statement -
(A) Both the compounds form same product on treatment with alcoholic KOH.
(B) Both the compounds form same production treatment with aq. NaOH
(C) Both the compounds form different product on reduction.
(D) Both the compounds are optically active.

Q.109 Compounds X and Z in the following reaction are -

$$CH_3CHO \xrightarrow[(ii)\ H_2O]{(i)\ CH_3MgBr} (X) \xrightarrow{H_2SO_4,\ \Delta} (Y) \xrightarrow[\text{oxidation}]{\text{Hydroboration}} (Z)$$

(A) identical
(B) positional isomers
(C) functional isomers
(D) optical isomers

Q.110  Major product is -

(A) 
(B) 
(C) 
(D) 

BIOLOGY

Q.111 Every CO_2 molecule entering the Calvin cycle needs -
(A) 2 molecule of NADPH and 3 molecule of ATP for its fixation
(B) 2 molecule of NADPH and 2 molecule of ATP for its fixation
(C) Variable amount of ATP
(D) Only NADPH

Q.112 The inner most layer of microsporangium is -
(A) Tapetum (B) Endothecium
(C) Middle layer (D) Epidermis

Q.113 When alleles of two contrasting characters are present together, one of the character expresses itself during the cross while the other remains hidden. This is the -
(A) Law of purity of gametes
(B) Law of segregation
(C) Law of dominance
(D) Law of independent assortment

Q.114 The chromosomal denotation for heterogametic female and homogametic males are -
(A) ZW and ZZ
(B) ZO–XX
(C) XX–XO
(D) Both (A) and (B)

Q.115 The Cri–du–chat is syndrome is caused by change in chromosome structure involving -

(A) Deletion (B) Duplication

(C) Inversion (D) Translocation

Q.116 I. Trisomy of sex (X) chromosome.

II. XXY + 44

III. 21st trisomy

IV. Sterile male

V. Gynaecomsatia

Choose the correct option for Klinefelter's syndrome.

(A) I, II, III and IV

(B) I, II, IV and V

(C) II, III, IV and V

(D) I, III, IV and V

Q.117 5-methyl uracil is -

(A) Modified ribose sugar

(B) Modified deoxyribose sugar

(C) Modified purine

(D) Modified pyrimidine

Q.118 In bacteria, which enzyme catalyses the transcription of all types of RNA (mRNA, tRNA and rRNA) -

(A) DNA dependent RNA polymerase

(B) DNA dependent DNA polymerase

(C) RNA dependent RNA polymerase

(D) RNA dependent DNA polymerase

Q.119 In a lac operon model, operator region is present -

(A) Adjacent to regulatory genes

(B) Adjacent to promoter genes

(C) Adjacent to structural genes

(D) Adjacent to intron

Q.120 Which of the following components are used in gel electrophoresis?

I. Ethidium bromide

II. Restriction endounclease

III. Agarose

IV. UV radiation

Choose the correct option -

(A) I and II

(B) I and III

(C) I, II and IV

(D) I, II, III and IV

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-4

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 The position vectors of three points A, B, C are $\hat{i}+2\hat{j}+3\hat{k}$, $2\hat{i}+3\hat{j}+\hat{k}$ & $3\hat{i}+\hat{j}+2\hat{k}$. A unit vector perpendicular to the plane of the triangle ABC is -

(A) $\left(-\frac{1}{\sqrt{3}}\right)(\hat{i}+\hat{j}+\hat{k})$

(B) $\left(\frac{1}{\sqrt{3}}\right)(\hat{i}-\hat{j}+\hat{k})$

(C) $\left(\frac{1}{\sqrt{3}}\right)(\hat{i}+\hat{j}-\hat{k})$

(D) none of these

Q.2 Solution set of inequality $\log_{\sin e}\log_0 x < 0$ is (where e is Napier's constant).

(A) $\left(\frac{1}{125},\infty\right)$ (B) $\left(-\infty,\frac{1}{125}\right)$

(C) $\left(0,\frac{1}{125}\right)$ (D) none of these

Q.3 Let $(1+x^2)^2(1+x)^n = A_0 + A_1 x + A_2x^2 + \ldots$ If A_0, A_1, A_2 are in A.P. then the value of n is -

(A) 2 (B) 4 (C) 5 (D) 7

Q.4 If z_1 and z_2 are two complex numbers such that $Re\,(z_2) \neq 0$, $Re(z_1+z_2)=0$ and $Im\,(z_1z_2)=0$ then -

(A) $z_1 = z_2$ (B) $z_1 = \bar{z}_2$

(C) $z_1 = -\bar{z}_2$ (D) none of these

Q.5 The derivative of $f(x) = |x|^3$ at $x = 0$ is -
(A) -1 (B) 0
(C) 1 (D) does not exist

Q.6 $\int_{\pi/4}^{\pi/2} \sqrt{2+\sqrt{2+2\cos 4x}}\, dx$ is equal to -
(A) $\sqrt{2}$ (B) $\sqrt{2}(\sqrt{2}-1)$
(C) 2 (D) none of these

Q.7 $\int \frac{x^3 dx}{\sqrt{1+x^2}}$ equals -
(A) $\frac{(1+x^2)^{3/2}}{3}\sqrt{1+x^2}+c$
(B) $x^2\sqrt{1+x^2}-\frac{1}{3}\sqrt{(1+x^2)^3}=c$
(C) $\frac{1}{3}x^2\sqrt{1+x^2}-\frac{2}{3}\sqrt{(1+x^2)^3}+c$
(D) none of these

Q.8 The number of real solutions of the equation,
$\cot^{-1}(x-1)+\cot^{-1}(6-x)=\cot^{-1}(x-2)$ is -
(A) 0 (B) 1
(C) 2 (D) infinite

Q.9 $y = f(x)$ is a continuous function such that its graph passes through $(a, 0)$. Then
$\lim_{x\to a} \frac{\log_e(1+3f(x))}{2f(x)}$ is -
(A) 1 (B) 0 (C) 3/2 (D) 2/3

Q.10 If the matrix $\begin{bmatrix} 1 & 2a & 2 \\ 0 & -1 & 1 \\ a & 1 & 3 \end{bmatrix}$ is not equivalent to I_3 then a is, $a \in R$.
(A) 1
(B) 2
(C) 4
(D) No such 'a' exists

Q.11 If $x, y \in R$ and $x - y = 2$ then minimum value of $x + y + xy$ is -
(A) 2 (B) -2 (C) 0 (D) 1

Q.12 If $f(x)$ is a differentiable function satisfying $f'(x) < 2$ for all $x \in R$ and $f(1) = 2$, then greatest possible integral value of $f(3)$ is -
(A) 5 (B) 6 (C) 7 (D) 8

Q.13 Tangents are drawn from a point on the directrix to the parabola $y^2 = 4ax$. The locus of foot of perpendicular drawn from this point to its chord of contact is a -
(A) straight line (B) point
(C) circle (D) parabola

Q.14 The number of non negative integral solution of the equation, $x + y + 3z = 33$ is -
(A) 120 (B) 135 (C) 210 (D) 520

Q.15 A missile is fired at a plane on which there are two targets I and II. The probability of hitting target I is P_1 & that of hitting the II is P_2. If it is known that target I is not hit, then the probability that the target II is hit is -
(A) $\frac{P_2}{P_1+P_2-P_1P_2}$ (B) $\frac{P_2(1-P_1)}{1-P_1P_2}$
(C) $P_2(1-P_1)$ (D) $\frac{P_2}{1-P_1}$

Q.16 If A. M. between p^{th} and q^{th} terms of an A.P. be equal to the A.M. between r^{th} and s^{th} term of the A.P. then $p + q$ is equal to -
(A) $r+s$ (B) $\frac{r-s}{r+s}$
(C) $\frac{r+s}{r-s}$ (D) $r+s+1$

Q.17 The lines $y = -\frac{3}{2}x$ and $y = -\frac{2}{5}x$ intersect the curve $3x^2 + 4xy + 5y^2 - 4 = 0$ at the points P and Q respectively. The tangents drawn to the curve at P and Q.
(A) intersect each other at angle of 45°
(B) are parallel to each other
(C) are perpendicular to each other
(D) none of these

Q.18 $\sin 47° + \sin 61° - \sin 11° - \sin 25°$ is equal to -

(A) $\sin 36°$ (B) $\cos 36°$

(C) $\sin 7°$ (D) $\cos 7°$

Q.19 The lengths of the diagonals of a parallelogram constructed on the vectors $\vec{p} = 2\vec{a} + \vec{b}$ & $\vec{q} = \vec{a} - 2\vec{b}$ where $\vec{a}$ & $\vec{b}$ are unit vectors forming an angle of 60° are -

(A) 3 & 4 (B) $\sqrt{7}$ & $\sqrt{13}$

(C) $\sqrt{5}$ & $\sqrt{11}$ (D) none of these

Q.20 Let z_1, z_2, z_3, z_4 be the vertices A, B, C, D respectively of a square on the argand plane taken in anticlockwise direction, then -

(A) $2z_4 = (1 - i)\, z_1 + (1 + i)\, z_1$

(B) $2z_1 = (1 - i)\, z_1 + (1 + i)\, z_3$

(C) $2z_4 = (1 + i)\, z_1 + (1 - i)\, z_3$

(D) $3z_1 = (1 + i)\, z_1 + (1 - i)\, z_3$

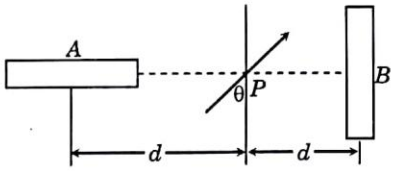
PHYSICS

Q.21 Two bar magnets of the same mass, same length and breadth but having magnetic moments M and $2M$ are joined together pole for pole and suspended by a string. The time period of assembly in a magnetic field of strength H is 3 seconds. If now the polarity of one of the magnets is reversed and the combination is again made to oscillate in the same field, the time period of oscillation is :

(A) $\sqrt{3}$ sec (B) $3\sqrt{3}$ sec

(C) 3 sec (D) 6 sec

Q.22 Two magnets A and B are identical and these are arranged as shown. Their lengths are negligible in comparison to separation between them. A magnetic needle is placed between the magnets at point P and it gets deflected through an angle θ. The ratio of distances d_1 and d_2 will be



(A) $(2 \cot \theta)^{1/3}$ (B) $(2 \tan \theta)^{1/3}$

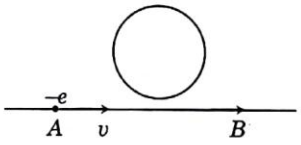
(C) $(2 \cot \theta)$ (D) $(2 \tan \theta)^{-1/3}$

Q.23 The tangent galvanometers having coils of the same radius are connected in series. A current flowing in them produces deflections of 60° and 45° respectively. The ratio of the number of turns in the coil is :

(A) (4/3) (B) $(\sqrt{3}+1)/1$

(C) $\left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right)$ (D) $\sqrt{3}/1$

Q.24 An electron moves along the line AB which lies in the same plane as a circular loop of conducting wire as shown in figure. What will be the direction of the current induced if any in the loop ?



(A) No current will be induced

(B) The current will be clockwise

(C) The current will be anticlockwise

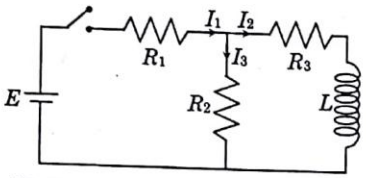
(D) The current will change direction as the electron passes by

Q.25 A solenoid has 2000 turns wound over a length of 0.3m. The area of its cross-section is 1.2×10^{-3} m². Around its central portion a coil of 300 turns is wound. If an initial current of 2 amp in the solenoid is reversed in 0.25 sec., the emf induced in the coil is equal to –

(A) 6×10^{-4} V (B) 48 mV

(C) 6×10^{-2} V (D) 48 kV

Q.26 In the circuit shown in the following figure $E = 10V$, $R_1 = 2$ ohm, $R_2 = 3$ ohm and $R_3 = 6$ ohm and $L = 5$ henry. The current I_1 just after pressing the switch S is



(A) 2.5 amp (B) 2 amp
(C) 5/6 amp (D) 5/3 amp

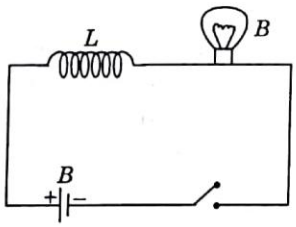
Q.27 In the Q.26, the current I_1 long after pressing the switch is

(A) 2.5 amp (B) 2 amp
(C) 5/6 amp (D) 5/3 amp

Q.28 When a ferromagnetic material is taken through a hysteresis cycle, the magnetic susceptibility cannot be :

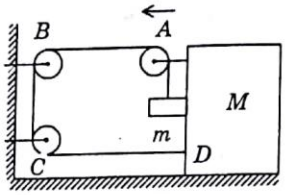
(A) Zero (B) Infinity
(C) Negative (D) Constant

Q.29 In the circuit of figure the bulb will become suddenly bright if :



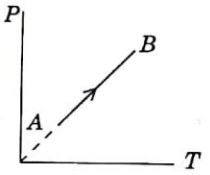
(A) Contact is made or broken
(B) Contact is made
(C) Contact is broken
(D) Would not become bright at all

Q.30 In figure shown, find the magnitude of acceleration of m, given that string is inextensible and mass less and the acceleration of M is 2 m/s² toward left –



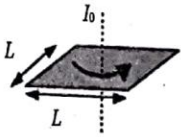
(A) $2\sqrt{3}$ m/s² (B) $3\sqrt{2}$ m/s²
(C) $4\sqrt{2}$ m/s² (D) $2\sqrt{5}$ m/s²

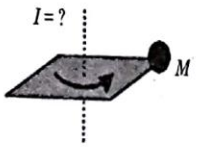
Q.31 During the process A-B for an ideal gas –



(A) Work done on the gas is zero
(B) Density of the gas is constant
(C) Slope of line AB from the T-axis is directly proportional to the number of moles of the gas
(D) All of the above

Q.32 A square of mass M and sides of length L has a moment of inertia I_0 when rotated about an axis perpendicular to its surface and passing through its center, as shown. Now a lump of clay, also of mass M is attached to one corner of the square as shown. What is the new moment of inertia of the masses about the same axis of rotation ?





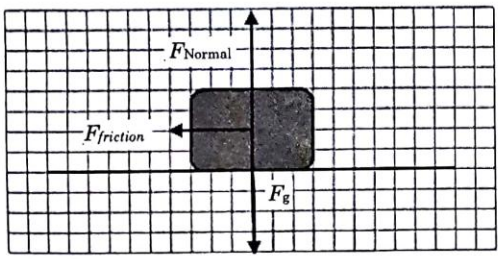
(A) $I_0 + \frac{ML^2}{4}$ (B) $I_0 + \frac{ML^2}{2}$
(C) $I_0 + \frac{\sqrt{2}ML^2}{2}$ (D) $I_0 + 2ML^2$

Q.33 A block of mass m is pushed across a rough surface by an applied force F, directed at an angle θ relative to the horizontal as shown. The block experiences a friction force f in the opposite direction. What is the coefficient of friction between the block and the surface?

(A) $\frac{mg}{F\sin\phi}$ (B) $\frac{f}{F\sin\phi + mg}$

(C) $\frac{f}{mg}$ (D) $\frac{mg}{f}$

Q.34 The free-body diagram shows all forces acting on a box supported by a stationary horizontal surface, where the length of each force vector is proportional to its magnitude. Which statement below is correct ?



(A) The box must be moving to the left, due to the force of friction acting in that direction

(B) The box must be accelerating to the right, as indicated by the force of friction in the opposite direction

(C) The box must be moving to the right, as indicated by the force of friction in the opposite direction

(D) None of these statements is correct

Q.35 A mass m in three-dimensional space is subjected to three forces : F_1, F_2 and F_3. F_1 and F_2 have the same magnitude, with F_1 in the positive-x direction, and F_2 in the positive-y direction. If the mass has an acceleration of 0, which of the following statements is false?

(A) The magnitude of F_3 is the same as that of F_1

(B) The object is in equilibrium and could be stationary

(C) F_3 lies in the x-y plane

(D) The object is in equilibrium and could be moving

Q.36 A cube of mass 30 g wettable by water floats on the surface of water. Each face of the cube is 4 cm long. Surface tension of water = 70 dynes/cm. The distance of the lower face of the cube from the surface of water is (g = 980 cm s^{-2}) :

(A) 1.9 cm (B) 1.93 cm

(C) 1.95 cm (D) 1.98 cm

Q.37 An object is placed 21 cm in front of a concave mirror of radius of curvature 10 cm. A glass slab of thickness 3 cm and refractive index 1.5 is then placed close to the mirror in the space between the object and the mirror. The distance of the near surface of the slab from the mirror is 1 cm. The final image from the mirror will be formed at :

(A) 4.56 cm (B) 5.65 cm

(C) 6.56 cm (D) 7.67 cm

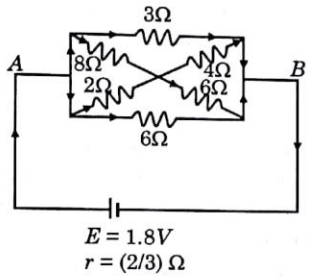
Q.38 A simple pendulum has a period T on the earth. What is the period T' of this same pendulum on the moon, where the acceleration due to gravity is 1/6 that of the earth?

(A) $\frac{T}{\sqrt{6}}$ (B) $\frac{T}{6}$ (C) $\sqrt{6}T$ (D) $36T$

Q.39 An aeroplane is flying in a horizontal circle at a speed of 540 km/h. Banked for this turn, the wings of the plane are tilted at an angle 45° from the horizontal. Assume that a lift force acting perpendicular to the wings holds the aircraft in the sky. The radius of the circle in which the plane is flying is (Take $g = 10$ m/s²)

(A) 1000 m (B) 2250 m
(C) 500 m (D) 4500 m

Q.40 In the adjoining figure, the emf of the cell is 1.8 V and the internal resistance is (2/3) Ω. The current in 3 Ω resistance is :



(A) 0.4 A (B) 0.8 A (C) 0.2 A (D) 0.1 A

CHEMISTRY

Q.41 The half-life of a radioactive isotope is 3 hours. If the initial mass of the isotope were 256 gm, the mass of it remaining undecayed after 18 hours would be -

(A) 4 gm (B) 8 gm
(C) 12 gm (D) 16 gm

Q.42 In $FeCr_2O_4$, the oxidation numbers of Fe and Cr are -

(A) + 2 and + 3 (B) 0 and + 2
(C) + 2 and + 6 (D) + 3 and + 6

Q.43 For Zn^{+2} / Zn, $E^\circ = -0.76$ V, for Ag^+/Ag $E^\circ = 0.799$ V. The correct statement is -

(A) the reaction Zn getting reduced Ag getting oxidized is spontaneous.
(B) Zn undergoes reduction and Ag is oxidized.
(C) Zn undergoes oxidation Ag^+ gets reduced.
(D) No suitable answer.

Q.44 There hydridizations of $Ni(CN)_4$ and $Cr(H_2O)_6^{2+}$, respectively =

(A) sp^3 and d^3sp^2 (B) dsp^2 and d^2sp^3
(C) sp^3 and d^2sp^3 (D) dsp^2 and sp^3d^2

Q.45 Copper crystallizes in a structure of face centered cubic unit cell. The atomic radius of copper is 1.28 Å. What is axial length on an edge of copper.

(A) 2.16 Å (B) 3.62 Å
(C) 3.94 Å (D) 4.15 Å

Q.46 For non-ideal solution showing positive deviation from Raoult's law, the enthalpy and volume of mixing of two liquids, respectively, are -

(A) +ve and + ve (B) +ve and zero
(C) –ve and zero (D) –ve and –ve

Q.47 Which of the following metals may be present in the anode mud during electrorefining of copper ?

I. Gold ; II. Iron, III. Silver ; IV. Magnesium

(A) I and II (B) II and IV
(C) I and II (D) III and IV

Q.48 Concentrated aqueous ammonia dissolve(s) which of the following completely ?

(A) AgCl (B) AgBr
(C) Ag_2CrO_4 (D) All of these

Q.49 Which of the following metal salts gives a red and opaque borax bead in the reducing flame (in cold) ?

(A) Ni (B) Fe (C) Cu (D) Mn

Q.50 Potassium manganate (K_2MnO_4) is formed when -

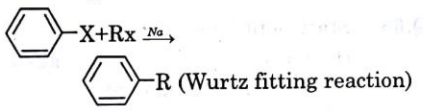
(A) cuprous oxide reacts with alkaline $KMnO_4$ solution.
(B) manganese dioxide is fused with K_2CO_2 in presence of KNO_3.
(C) formaldehyde reacts with potassium permanganate in presence of concentrated potassium hydroxide solution.
(D) in all of the above.

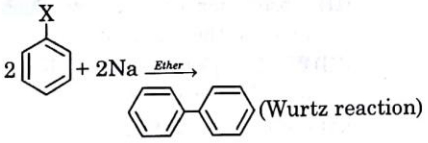
Q.51 Aluminium does not react with -
(A) NaOH (B) conc. HCl
(C) N_2 (D) conc. HNO_3

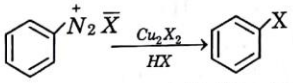
Q.52 Healing of ammonium dichromate produces -
(A) NH_3, Cr_2O_3 and H_2O
(B) N_2, Cr_2O_3 and H_2O
(C) NO_2, CrO_3 and H_2O
(D) N_2O, CrO_3 and H_2O

Q.53 Which of the following is not hydrophobic sol ?
(A) Protein sol (B) Gold sol
(C) $Fe(OH)_3$ sol (D) None of these

Q.54 Which is the incorrect match for the following name reactions ?

(A)  (Wurtz fitting reaction)

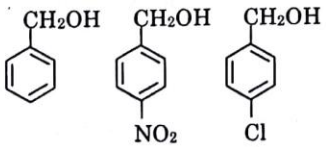
(B)  (Wurtz reaction)

(C)  + N_2 (Sandmeyer reaction)

(D) $C_2H_5Cl + NaI \xrightarrow{Dry\ Acetone} C_2H_5I + NaCl$ (Finkelstein reaction)

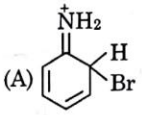
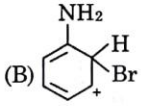
Q.55 Phenol is less acidic then ..... .
(A) ethanol (B) o-nitrophenol
(C) o-methylphenol (D) o-methoxyphenol

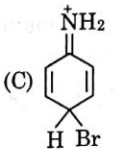
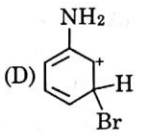
Q.56 Mark the correct increasing order of reactivity of the following compounds with HBr/HCl.


(a) (b) (c)

(A) a < b < c (B) b < a < c
(C) b < c < a (D) c < b < a

Q.57 Arenium ion involved in the bromination of aniline except :

(A)  (B) 

(C)  (D) 

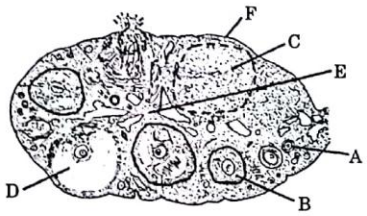
Q.58 Dinucleotide is obtained by joining two nucleotides together by phosphodiester linkage. Between which carbon atoms of pentoe sugars of nucleotides are these linkages present ?
(A) 5 and 3 (B) 1 and 5
(C) 5 and 5 (D) 3 and 3

Q.59 Molecules whose mirror image is non superimposable over them are known as chiral. Which of the following molecules is chiral in nature ?
(A) 2-Bromobutane
(B) 1-Bromobutane
(C) 2-Bromopropane
(D) 2-Bromopropan-2-ol

Q.60 Which of the following statements is wrong ?
(A) Cationic detergents have germicidal properties
(B) Bacteria can degrade the detergents containing highly branched chains
(C) Some synthetic detergents can give foam even in ice cold water.
(D) Synthetic detergents are not soaps

BIOLOGY

Q.61 The correct match from the figure is -



(A) A = primary follicle, B = maturing follicle, C = corpus luteum, D = graafian follicle, E = medulla, F = germinal epithelium

(B) A = corpus luteum, B = maturing follicle, C = primary follicle, D = graafian follicle, E = medulla, F = germinal epithelium

(C) A = graafian follicle, B = maturing follicle, C = primary follicle, D = corpus luteum, E = germinal epithelium, F = medulla

(D) A = maturing follicle, B = corpus luteum, C = primary follicle, D = graafian follicle, E = germinal epithelium, F = medulla

Q.62 Which of the following is correct about ear ossicles ?

(A) They are present in the middle ear

(B) The 3 ear ossicles (malleus, incus and stapes) are attached to one other in a chain-like fashion

(C) Malleus is attached to the ear drum and stapes to the oval window

(D) All

Q.63 The corpus luteum :

(A) Is found in midbrain of human

(B) Is formed from the remnants of graafian follicles after ovulation

(C) Secretes mainly LH

(D) Is found in testis

Q.64 Match the Column-I with Column-II –

Column-I	Column-II
a. FSH	i. Transported axonally to neurohpophysis from hypothalamus
b. MSH	ii. Acts on melanocytes and regulates pigmentation of skin
c. Vasopressin (ADH)	iii. Stimulates the growth and development of ovarian follicles in female
d. Pars intermedia	iv. In human, it is almost merged with pars distalis

(A) a-iii, b- ii, c-i, d-iv

(B) a-i, b-ii, c-iii, d-iv

(C) a-iv, b-iii, c-ii, d-i

(D) a-iii, b-ii, c-iv, d-i

Q.65 Statement true or false is -

(I) No absorption of food takes place in mouth & oesophagus

(II) Absorption of water & alcohol takes place in the stomach

(III) Whole protein particles can be absorbed by colon

(A) I & II true, III false

(B) I & III true, II false

(C) I, II, III true

(D) II & III true, I false

Q.66 Which statement is wrong -

(A) Painful urination is known dysuria

(B) Loop of Henle's present in the medulla

(C) Outer wall of Bowman's capsule is made up of stratified epithelial cells

(D) Bowman's capsule, PCT & DCT are present in the cortex

Q.67 Glomerular filtrate is-

(A) Blood minus blood corpuscles

(B) Mixture of Blood corpuscles, NaCl and Water

(C) Blood minus, blood corpuscles & plasma proteins

(D) Blood corpuscles and urea

Q.68 The process by which chloride ions pass into R.B.C. and bicarbonate ions pass out is called -
(A) Bicarbonate shift
(B) Chloride shift
(C) Buffer system
(D) Enzyme shift

Q.69 Polyspermy is prevented by -
(A) Formation of fertilization membrane
(B) Formation of vitelline membrane
(C) Aglutitiuin reaction
(D) Zona pellucida

Q.70 Untreated victims of severe combined immunodeficiency usually die from -
(A) Infections that in other people are minor
(B) Anaphylactic shock
(C) Congested lungs
(D) Unusually high fever

Q.71 Correct sequence of cell stages in spermatogenesis is-
(A) Spermatocytes, Spermatids, Spermatogonia, Spermatozoa
(B) Spermatogonia, Spermatocytes, Spermatids, Spermatozoa
(C) Spermatocytes, Spermatogonia, Spermatids, Spermatozoa
(D) Spermatogonia, Spermatids, Spermatocytes, Spermatozoa.

Q.72 If CO_2 is absent in atmosphere of earth then :
(A) Temperature will decrease
(B) Temperature will increase
(C) Plants will flourish well
(D) No effect

Q.73 Homo sapiens have evolved in :
(A) Paleocene (B) Plestocene
(C) Oligocene (D) Myocene

Q.74 Identify the edible freshwater teleosts -
(A) Sharks (B) Catla catla
(C) Rays and skates (D) Hilsa hilsa

Q.75 Which of following contraception method prevents from both pregnancy and STD -
(A) IUD (B) Vaults
(C) Diaphragm (D) Condom

Q.76 The gametophyte of moss is -
(A) Seta (B) Capsule
(C) Zygote (D) Protonema

Q.77 Gymnosperms are characterized by -
(A) Multiflagellate sperms
(B) Naked seeds
(C) Winged seeds
(D) Seeds inside fruits

Q.78 Which of the following feature is common to prokaryotes and many eukaryotes ?
(A) Cell wall is present
(B) Chromosomes are present
(C) Sub-cellular organelles are present
(D) Nuclear membrane is present

Q.79 I. Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.
II. Nuclear envelope assembles around the chromosome clusters.
III. Nucleolus, Golgi complex and ER reform.
Above features indicates which phase of mitosis.
(A) Anaphase (B) Telophase
(C) Cytokinesis (D) S-phase

Q.80 Chlorophyll-*a* and chlorophyll-*b* differs in having -
(A) Chlorophyll-*a* has methyl group and chlorophyll-*b* has aldehyde group in position *X*
(B) Chlorophyll-*a* has aldehyde group and chlorophyll-*b* has methyl group in position *X*
(C) Chlorophyll-*a* has carbonyl group and chlorophyll-*b* has aldehyde group in position *X*
(D) Chlorophyll-*a* has ethyl group and chlorophyll-*b* has aldehyde group in position *X*

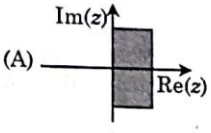
PART-II [Two Marks Questions]

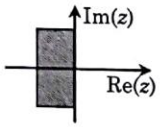
MATHEMATICS

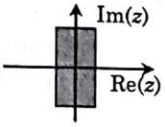
Q.81 If $x = \frac{4\lambda}{1+\lambda^2}$ and $y = \frac{2-2\lambda^2}{1+\lambda^2}$ where λ is a real parameter and $x^2 - xy + y^2$ lies between $[a, b]$ then $(a + b)$ is-

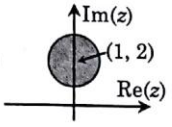
(A) 8 (B) 10 (C) 13 (D) 25

Q.82 If the shaded portion represents the set of complex numbers then which of the following set of complex numbers satisfy the inequality $\tan^{-1}(\log_3 |2z-1|) > \tan^{-1}(\log_3 |2z+1|)$

(A) 

(B) 

(C) 

(D) 

Q.83 The tangent at a point whose eccentric angle 60° on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1\ (a>b)$ meet the auxiliary circle at L and M. If LM subtends a right angle at the centre, then eccentricity of the ellipse is-

(A) $\frac{1}{\sqrt{7}}$ (B) $\frac{2}{\sqrt{7}}$ (C) $\frac{3}{\sqrt{7}}$ (D) $\frac{1}{2}$

Q.84 Let $f(x) = \lim_{n\to\infty} n^2\left(x^{\frac{1}{n}} - x^{\frac{1}{n+1}}\right)$; $x > 0$, then $\int xf(x)\,dx$ equals to

(A) $\frac{x^2}{2}\ell n\, x + c$

(B) $-\frac{x^2}{4}\ell n\, x + \frac{x^2}{2} + c$

(C) $\frac{x^2}{2}\ell n\, x + \frac{x^2}{4} + c$

(D) $\frac{x^2}{2}\ell n\, x - \frac{x^2}{4} + c$

Q.85 (a, b) and (c, d) are solutions of simultaneous equation $5(\log_y x + \log_x y) = 26$, $xy = 64$ then $a + b + c + d =$

(A) 51 (B) 17 (C) 68 (D) 34

Q.86 $\lim_{n\to\infty}\left(\left(\frac{n}{n+1}\right)^{\alpha} + \sin\frac{1}{n}\right)^n$ $(\alpha \in Q)$ is equal to

(A) e^{α} (B) $-\alpha$ (C) $e^{1-\alpha}$ (D) $e^{1+\alpha}$

Q.87 If $\alpha = \lim_{n\to\infty}\left(\frac{1}{n^3+1}+\frac{4}{n^3+1}+.....+\frac{n^2}{n^3+1}\right)$ and $\beta = \lim_{x\to 0}\frac{\sin 2x}{\sin 8x}$ then the quadratic equation whose roots are α, β is

(A) $12x^2 - 7x + 1 = 0$

(B) $x^2 + 19x - 120 = 0$

(C) $x^2 - 17x + 60 = 0$

(D) $x^2 - 7x + 12 = 0$

Q.88 A function $y = f(x)$ satisfies the condition $f'(x)\sin x + f(x)\cos x = 1$, $f(x)$ being bounded when $x \to 0$. If $I = \int_0^{\pi/2} f(x)\,dx$, then

(A) $\frac{\pi}{2} < I < \frac{\pi^2}{4}$ (B) $\frac{\pi}{4} < I < \frac{\pi^2}{2}$

(C) $1 < I < \frac{\pi}{2}$ (D) $0 < I < 1$

Q.89 If min. $\{x^2 + (a - b)x + 1 - a - b\} >$ max. $\{-x^2 + (a + b)x - (1 + a + b)\}$ then –

(A) $a^2 + b^2 < 2$ (B) $a^2 + b^2 < 4$

(C) $a^2 + b^2 > 4$ (D) $a + b > ab$

Q.90 If the sum

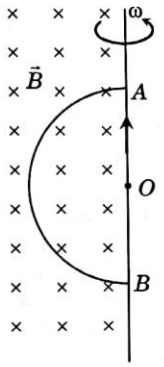
$$\sum_{k=1}^{\infty}\frac{1}{(k+2)\sqrt{k}+k\sqrt{k+2}} = \frac{\sqrt{a}+\sqrt{b}}{\sqrt{c}}$$

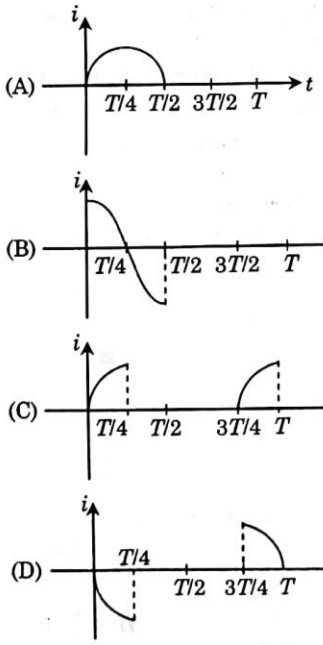
where $a, b, c \in N$ and lie in $[1, 15]$, then $a + b + c$ equals to-

(A) 6 (B) 8 (C) 10 (D) 11

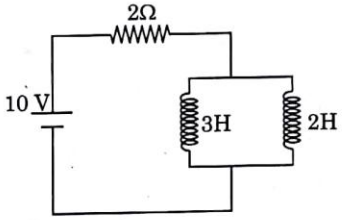
PHYSICS

Q.91 A semicircular loop of radius R is rotated about its straight edge which divides the space into two regions one having a uniform magnetic field B and the other having no field. If initially the plane of loop is perpendicular to $\vec{B}$ (as shown), and if current flowing from O to A be taken as positive, the correct plot of induced current v/s time for one time period is -



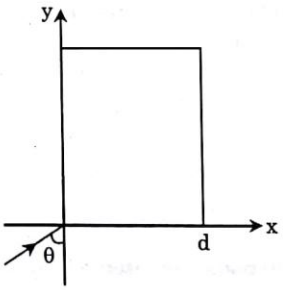


Q.92 Both the inductors and the cell are ideal. Find the current (in Amperes) in 2H inductance in steady state.



(A) zero (B) 1A (C) 2A (D) 3A

Q.93 A ray hits the y-axis making an angle θ with y-axis as shown in the figure. The variation of refractive index with x-coordinate is $\mu = \mu_0\left(1-\frac{x}{d}\right)$ for $0 \le x \le d$, $\left(1-\frac{1}{\mu_0}\right)$ and $\mu = \mu_0$ for $x < 0$, where d is a positive constant. The maximum x-coordinate of the path traced by the ray is -



(A) $d(1 - \sin\theta)$ (B) $d(1 - \cos\theta)$
(C) $d \sin\theta$ (D) $d \cos\theta$

Q.94 A cobalt (atomic no. = 27) target is bombarded with electrons, and the wavelengths of its characteristic x-rays spectrum are measured. A second weak characteristic spectrum is also found, due to an impurity in the target. The wavelength of the K_α lines are 225.0 pm (cobalt) and 100.0 pm (impurity). Atomic number of the impurity is (take $b = 1$)

(A) 39 (B) 40 (C) 59 (D) 60

Q.95 The conducting spheres of radii r and $3r$ initially have charges $3q$ & q respectively. Their separation is much larger than their radii. If they are joined by a conductor of high resistance, the force between them will -

(A) increase continuously

(B) decrease continuously

(C) first increase, then decrease

(D) first decrease, then increase

Q.96 In an LRC series circuit at resonance, current in the circuit is $10\sqrt{2}$ A. If now frequency of the source is changed such that now current lags by 45° than applied voltage in the circuit. Which of the following is correct is -

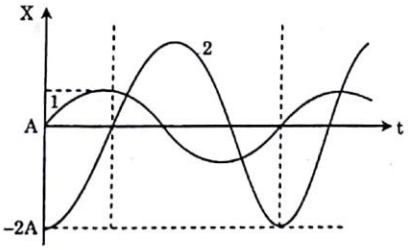
(A) frequency must be increased and current after the change is 10 A

(B) frequency must be decreased and current after the change is 10 A

(C) frequency must be decreased and current is same as that of initial value

(D) the given information is insufficient to conclude anything

Q.97 The oscillations represented by curve 1 in the graph are expressed by equation $x = A \sin\omega t$. The equation for the oscillations represented by curve 2 is expressed as -



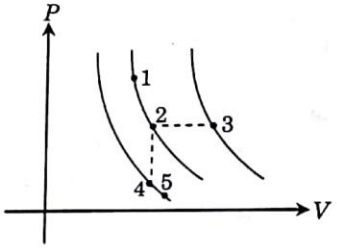
(A) $x = 2A \sin(\omega t - \pi/2)$

(B) $x = 2A \sin(\omega t + \pi/2)$

(C) $x = -2A \sin(\omega t - \pi/2)$

(D) $x = A \sin(\omega t - \pi/2)$

Q.98 A certain gas is taken to the five states represented by dots in the graph. The plotted lines are isotherms. Order of the most probable speed V_p of the molecules at these five states is -



(A) $V_{P\,at\,3} > V_{P\,at\,1} = V_{P\,at\,2} > V_{P\,at\,4} = V_{P\,at\,5}$

(B) $V_{P\,at\,1} > V_{P\,at\,2} = V_{P\,at\,3} > V_{P\,at\,4} > V_{P\,at\,5}$

(C) $V_{P\,at\,3} > V_{P\,at\,2} = V_{P\,at\,4} > V_{P\,at\,1} > V_{P\,at\,5}$

(D) insufficient information to predict the result.

Q.99 An electron of the kinetic energy 10 eV collides with a hydrogen atom in 1st excited state. Assuming loss of kinetic energy in the collision to be quantized which of the following statements is **incorrect**.

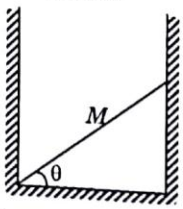
(A) The collision may be perfectly inelastic

(B) The collision may be inelastic

(C) The collision may be elastic

(D) The collision must be inelastic

Q.100 A uniform stick of mass M is placed in a frictionless well as shown. The stick makes angle θ was the horizontal. The force which the vertical wall exerts on right end of stick is -

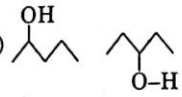


(A) $\frac{Mg}{2\cot\theta}$ (B) $\frac{Mg}{2\tan\theta}$

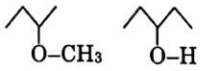
(C) $\frac{Mg}{2\cos\theta}$ (D) $\frac{Mg}{2\sin\theta}$

CHEMISTRY

Q.101 Which of the following can are correctly matched

(I)  position isomerism

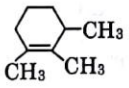
(II) $CH_3–NH–CH_2–CH(CH_3)–N(CH_3)–CH_3$ Functional group isomer

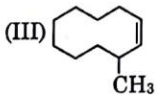
(III)  Functional group isomer

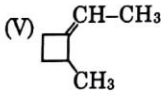
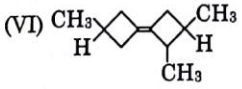
(A) I only (B) I, II, III

(C) II, III (D) I, II only

Q.102 Which of the following molecule can show optical isomerism, geometrical isomerism both.

(I)  (II) 

(III)  (IV) 

(V)  (VI) 

(A) I, II, III, IV, V only

(B) I, IV, V, VI only

(C) III, IV, V, VI only

(D) All of these

Q.103 Triplet state of Reaction intermediates like carbene & nitrene are more stable than their singlet state. This fact can be explained on the basis of -

(A) Triplet intermediates can show syn addition whereas singlet intermediates can also show the antiaddition

(B) State of minimum multiplicity is most stable state due to least energy

(C) The paired electronic configuration provides maximum multiplicity, which leads to more stabilization for intermediate

(D) The electron is separate orbitals bring the state of maximum multiplicity according to formula $2S + 1$, where S = sum of spin quantum numbers for all the electrons. This leads to net decrease in energy according to hunds rule of maximum multiplicity

Q.104 Hyper conjugation (HC) and reverse hyper conjugation (RHC) both are the example of σ-π conjugation. Which one of following statement is correct about the above two electronic effect -

(A) HC directing the $E^{\oplus}$ at meta position where as RHC activates the $E^{\oplus}$ at ortho & para position

(B) HC directing the $E^{\oplus}$ at ortho position RHC directing the $E^{\oplus}$ at meta & para position

(C) HC directing the $E^{\oplus}$ at ortho & para position, RHC directing $Nu^{\ominus}$ at ortho & para position

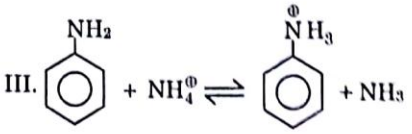
(D) None of these

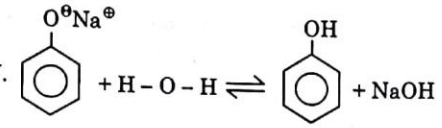
Q.105 In which of the following reaction backward reaction is favoured.

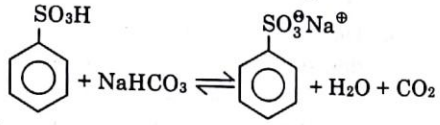
I $H–C\equiv C–H + \overset{\oplus}{Na}\overset{\ominus}{C}H_3 \rightleftharpoons CH_4 + H–C\equiv\overset{\ominus}{C}\overset{\oplus}{Na}$

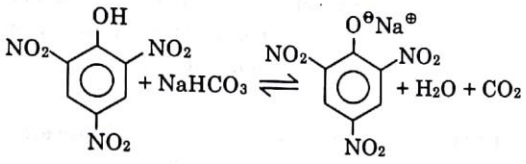
II. $CH_3–\underset{\underset{O}{\|}}{C}O–H + \overset{\oplus}{Na}\overset{\ominus}{O}CH_3 \rightleftharpoons$

$CH_3–\underset{\underset{O}{\|}}{C}\overset{\ominus}{O}\overset{\oplus}{Na} + CH_3OH$

III. 

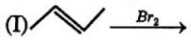
IV. 

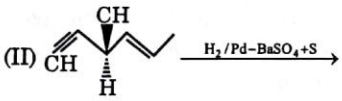
V. 

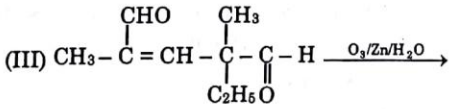
VI. 

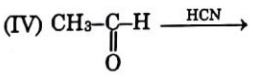
(A) I, II, III, IV only (B) III, IV, V only
(C) III, VI only (D) III, IV only

Q.106 Which of the following reaction produce achiral product-

(I) 

(II) 

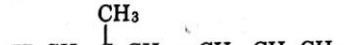
(III) 

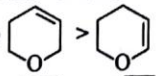
(IV) 

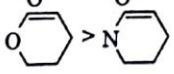
(A) I, II, III, IV (B) I, III only
(C) I, III, IV only (D) I, II, III only

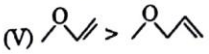
Q.107 Which of the following order is the correct order for reactivity of Acidic hydration on double bond (C=C)

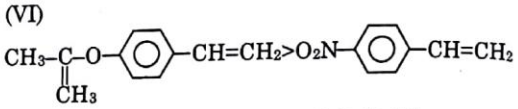
(I) $CH_3–CH=CH_2 > CH_2=CH–Cl$

(II) 

(III) 

(IV) 

(V) 

(VI) 

(A) I, II, III, VI (B) I, II, III
(C) I, II, V, VI (D) All are correct

Q.108 The complex showing a spin only magnetic moment of 3.87 BM is-

(A) $[NiCl_4]^{2-}$ (B) $[Cu(NH_3)_4]SO_4$
(C) $[CoCl_6]^{4-}$ (D) $[CrBr_6]^{3-}$

Q.109 Which one of the following compound does not follow EAN rule -

(A) $[Fe(CN)_6]^{-3}$
(B) $[V(CO)_6]$
(C) $[Ti(\sigma - C_5H_5)_2(\pi - C_5H_5)_2]^0$
(D) $[Fe(CO)_2(NO)_2]^{0+}$

Q.110 A reaction $2A_{(g)} \xrightarrow{k} B_{(g)} + 3C_{(g)}$ has $k = 0.98$ hr^{-1} initial pressure of A is $3P_0$ and that of B and C is zero. After time 't' the total pressure due to products is P_0. The value of kt for the reaction is:

(A) $\ell n3$ (B) $\ell n1/3$
(C) $1/2\ \ell n\ 1.2$ (D) None of these

BIOLOGY

Q.111 If dominant C and P genes are essential for the development of purple colour in sweet pea flowers, what would be the ratio of white and purple colour in a cross between CcPp × Ccpp -

(A) 5 : 3 (B) 9 : 7
(C) 2 : 6 (D) 6 : 2

Q.112 Male off spring of which of the following couples have the highest chance of haemophilia ?

(A) Haemophiliac father and normal non-carrier mother
(B) Haemophiliac father and normal carrier mother
(C) Normal father and normal carrier mother
(D) Normal father and haemophiliac mother

Q.113 Which of the following is Pribnow box ?

(A) 5'AATAAT3' (B) 5'ATATTA3'

(C) 5'TATAAT3' (D) 5'TAATTA3'

Q.114 Given below sequence of the processed m-RNA ready for translation :

5'AUG CUA UACCUCCUUUAUCUGUGA–3'.

How many different t-RNA molecule require to translate this m-RNA -

(A) 8 (B) 7 (C) 6 (D) 5

Q.115 Immune deficiency syndrome in human could develop as consequence of -

(A) AIDS virus infection

(B) Defective liver

(C) Defective thymus

(D) Weak immune system

Q.116 A gene encoding for polypeptide of 50 amino acids get mutated at 25 codon UAU becoming UAA. The result would be -

(A) Polypeptide of 24 amino acid

(B) Two polypeptides one with 24 amino acids and second with 25 amino acids

(C) A polypeptide with 49 amino acid

(D) A polypeptide of 25 amino acids

Q.117 In a cross between individuals homozygous for (a, b) and wild type (++) 700 out of 1000 individuals were of parental type. Then the distance between a and b is -

(A) 70 map unit (B) 35 map unit

(C) 30 map unit (D) 15 map unit

Q.118 Which type of restriction enzymes are used in recombinant DNA technology ?

(A) Type-I (B) Type-II

(C) Type-III (D) All of the above

Q.119 Given below is an incomplete table about certain hormones, their source glands and one major effect of each on the body in humans, identify the correct option for the three blanks A, B and C.

Gland	Secretion	Effect on Body
Ovary	A	Maintenance of secondary sexual characters in female
B	Glucagon	Raises blood sugar level
C	Growth hormone	Over secretion leads to gigantism

Option :

	A	B	C
(A)	Oestrogen	Islet of langerhance α-cells	Anterior lobe of pituitary
(B)	Insulin	Placenta	Posterior lobe of pituitary
(C)	Insulin	Ovary	Adrenaline
(D)	Glucagon	Placenta	Thyroid

Q.120 Which of the following crosses and resultant phenotypic ratios are mismatches.

	CROSS	PHENOTYPIC RATIO
(A)	TtYy × TtYy	9 : 3 : 3 : 1
(B)	TtYy × ttyy	1 : 1 : 1 : 1
(C)	tt × Tt	2 : 1
(D)	Tt × Tt	3 : 1

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-5

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 Consider the planes $3x - 6y + 2z + 5 = 0$ and $4x - 12y + 3z = 3$. The plane $67x - 162y + 47z + 44 = 0$ bisects the angle between the planes which -

(A) contains origin (B) is right angle

(C) is obtuse (D) none of these

Q.2 Let the number of positive and negative solutions of $x^2 - 6x - |5x - 15| - 5 = 0$ be ℓ and m respectively, then -

(A) $\ell + m = 2$ (B) $3\ell + m = 4$

(C) $3\ell - m = 2$ (D) All of these

Q.3 The number of values of 'r' satisfying the equation -

$^{39}C_{3r-1} - {}^{39}C_{r^2} = {}^{39}C_{r^2-1} - {}^{39}C_{3r}$ is -

(A) 1 (B) 2

(C) 3 (D) 4

Q.4 If $m = \frac{-1+\sqrt{-3}}{2}$ then the expression $(1-m)^2 (m-m^2)^2 (1-m^2)^2$ simplifies to -

(A) an imaginary number

(B) a prime number

(C) a positive integer

(D) a negative integer

Q.5 The function

$$f(x)=\begin{cases} x^2/a & 0\le x<1 \\ a & 1\le x<\sqrt{2} \\ (2b^2-4b)/x^2 & \sqrt{2}\le x<\infty \end{cases}$$

is continuous for $0 \le x < \infty$, then the most suitable values of a and b are -

(A) $a = 1, b = -1$

(B) $a = -1, b = 1 + \sqrt{2}$

(C) $a = -1, b = 1$

(D) none of these

Q.6 Evaluate –

$$\lim_{n\to\infty} \frac{1}{n}\left[1+\sqrt{\frac{n}{n+1}}+\sqrt{\frac{n}{n+2}}+\sqrt{\frac{n}{n+3}}+\ldots+\sqrt{\frac{n}{4n}}\right]$$

(A) $2\sqrt{2}$ (B) $2\sqrt{2}-1$

(C) 2 (D) 4

Q.7 Given $A=\begin{vmatrix} a & b & 2c \\ d & e & 2f \\ \ell & m & 2n \end{vmatrix}$, $B=\begin{vmatrix} f & 2d & e \\ 2n & 4\ell & 2m \\ c & 2a & b \end{vmatrix}$,

then -

(A) $2A + B = 0$ (B) $2A - B = 0$

(C) $A + 2B = 0$ (D) $A - 2B = 0$

Q.8 The differential equation, $x\frac{dy}{dx}+\frac{3}{\frac{dy}{dx}}=x^2$

(A) is of order 2 (B) is of degree 2

(C) is homogeneous (D) none of these

Q.9 Let $f(x) = [x]^2 + [x + 1] - 3$, where $[x]$ = the greatest integer $\le x$. Then -

(A) $f(x)$ is a many-one and into function

(B) $f(x) = 0$ for exactly five number of values of x

(C) $f(x) = 0$ for only two real values

(D) none of these

Q.10 A point P lies on the hyperbola $9x^2 - 16y^2 = 144$ such that $PS_1 : PS_2 = 3/2$ (where S_1 and S_2 are focii of hyperbola). Coordinates of point P is in the first quadrant are -

(A) $(4\sqrt{2}, 3)$ (B) $(8, 3\sqrt{3})$

(C) $\left(5, \frac{9}{4}\right)$ (D) $(16, 3\sqrt{15})$

Q.11 $\lim\limits_{x\to\infty} \frac{x^n}{e^x} = 0$ (n integer) for -

(A) no value of n

(B) all values of n

(C) only negative values of n

(D) only positive values of n

Q.12 If $y = f\left(\frac{3x+4}{5x+6}\right)$ & $f'(x) = \tan x^2$ then $\frac{dy}{dx} =$

(A) $\tan x^3$

(B) $-2\tan\left[\frac{3x+4}{5x+6}\right]^2 \cdot \frac{1}{(5x+6)^2}$

(C) $f\left(\frac{3\tan x^2+4}{5\tan x^2+6}\right)\tan x^2$

(D) none of these

Q.13 If $a < 0$, $f(x) = e^{ax} + e^{-ax}$ and $S = \{x; f(x)$ is monotonically decreasing$\}$; then S equals -

(A) $\{x : x > 0\}$ (B) $\{x : x < 0\}$

(C) $\{x : x > 1\}$ (D) $\{x : x < 1\}$

Q.14 A line passing through the point (21, 30) are normal to the curve $y = 2\sqrt{x}$ can have the slope -

(A) 2 (B) 3 (C) –2 (D) –5

Q.15 An ellipse is inscribed in a circle and a point within the circle is chosen at random. If the probability that this point lies outside the ellipse is 2/3 then the eccentricity of the ellipse is -

(A) $\frac{2\sqrt{2}}{3}$ (B) $\frac{\sqrt{5}}{3}$ (C) $\frac{8}{9}$ (D) $\frac{2}{3}$

Q.16 The number of all positive integral roots of the equation, $px = p + 15x$; $p \in N$ is -

(A) 3 (B) 4

(C) 5 (D) none of these

Q.17 If $\frac{1}{x+y}, \frac{1}{2y}, \frac{1}{y+z}$ are three consecutive terms of an A.P., then x, y, z are three consecutive terms of -

(A) an AP

(B) a GP

(C) an HP

(D) none of these

Q.18 The number of lines that can be drawn through the point (4, –5) at distance 12 units from the point (–2, 3) is -

(A) 0 (B) 1

(C) 2 (D) infinite

Q.19 The solution of $|\cos x| = \cos x - 2\sin x$ is -

(A) $x = n\pi$

(B) $x = n\pi + \frac{\pi}{4}$

(C) $x = n\pi + (-1)^n \frac{\pi}{4}$

(D) $x = (2n+1)\pi + \frac{\pi}{4}, n \in I$

Q.20 If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ & $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$, then the vector $\vec{c}$ such that $\vec{a} \cdot \vec{c} = 2$ & $\vec{a} \times \vec{c} = \vec{b}$ is -

(A) $\frac{1}{3}(\hat{i} - 2\hat{j} + \hat{k})$

(B) $\frac{1}{3}(-\hat{i} + 2\hat{j} + 5\hat{k})$

(C) $\frac{1}{3}(\hat{i} + 2\hat{j} - 5\hat{k})$

(D) $\frac{1}{3}(-\hat{i} + 2\hat{j} - 5\hat{k})$

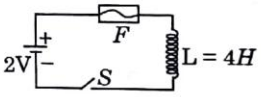
PHYSICS

Q.21 Two infinitely long charge wires with linear densities λ & 3λ are placed along x & y axis respectively determined the tan θ where θ is the angle that electric field at any point on the line $y = \sqrt{3}x$ make with positive x-axis -

(A) $3\sqrt{3}$ (B) $\frac{\sqrt{3}}{3\sqrt{2}}$

(C) $\frac{1}{3\sqrt{3}}$ (D) $\sqrt{3}$

Q.22 In the circuit shown the cell is ideal. The coil has an inductance of $4H$ and zero resistance. F is a fuse of zero resistance and will blow when the current through it reaches $5A$. The switch is closed at $t = 0$. The fuse will blow-



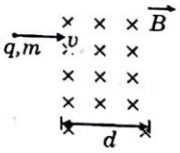
(A) after 5 sec

(B) after 2 sec

(C) after 10 sec

(D) Just after closing of S

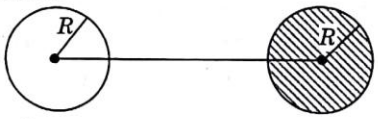
Q.23 A charged particle of mass m and charge q is projected into a uniform magnetic field of induction B with speed v which is perpendicular to B. The width of the magnetic field is d. The impulse imparted to the particle by the field is $(d << \frac{mv}{qB})$ -



(A) qBv (B) $\frac{mv}{qB}$

(C) qBd (D) $\frac{2mv^2}{qB}$

Q.24 A ring of radius R having a linear charge density λ moves towards a solid imaginary sphere of radius $R/2$, so that the centre of ring passes through the centre of sphere. The axis of the ring is perpendicular to the line joining the centers of the ring and the sphere. The maximum flux through the sphere in this process is -



(A) $\frac{\lambda R}{\epsilon_0}$ (B) $\frac{\lambda R}{2\epsilon_0}$ (C) $\frac{\lambda \pi R}{4\epsilon_0}$ (D) $\frac{\lambda \pi R}{3\epsilon_0}$

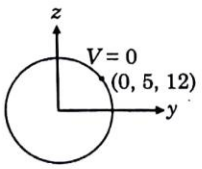
Q.25 Three point A, B & C are at a distance of 1m, 2m & 1m from an infinitely long charged wire of linear charge density λ C/m. A charge q is taken from A to B, B to C and finally C to A. Which of the following is/are correct about the work done in the above process -

(A) $W_{AB} = 2\,W_{BC}$ (B) $W_{AB} = -W_{BC}$
(C) $W_{BC} = 0$ (D) $W_{AB} = 0$

Q.26 A particle of charge Q and of negligible initial speed is accelerated through a potential difference of U. The particle reaches a region of uniform magnetic field of induction B, where it undergoes circular motion. If potential difference is doubled and B is also doubled then magnetic moment of the circular current due to circular motion of charge Q will become -

(A) double (B) half
(C) four times (D) remain same

Q.27 A infinitely long line charge of charge density λ lies along the x axis and let the surface of zero potential passes through (0, 5, 12)m. The potential at point (2, 3, – 4) is –



(A) $\frac{\lambda}{2\pi\epsilon_0}\ell n\frac{13}{5}$ (B) $\frac{2\lambda}{\pi\epsilon_0}\ell n\frac{13}{3}$
(C) $\frac{\lambda}{4\pi\epsilon_0}\ell n\frac{13}{5}$ (D) $-\frac{\lambda}{2\pi\epsilon_0}\ell n\frac{13}{5}$

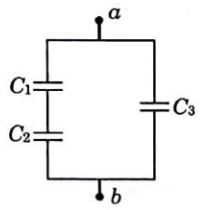
Q.28 A sample of radioactive material decays simultaneously by two processes A & B with half lives $\frac{1}{2}$ & $\frac{1}{4}hr$ respectively. For first half hr it decays with the process A, next one hr with the process B & for further half an hour with both A & B. If originally there were N_0 nuclei the number of nuclei after 2 hr of such decay $N_0\left(\frac{1}{2}\right)^a$ then find the value of a -

(A) 2 (B) 4 (C) 8 (D) 1

Q.29 Two mutually perpendicular infinitely long lines of charge having charge per unit length as λ_1 and λ_2 are located in air at a distance "a" from each other. The force of interaction between them is -

(A) $\frac{\lambda_1\lambda_2}{4\epsilon_0\,\pi a}$ (B) $\frac{\lambda_1\lambda_2}{\pi a\,\epsilon_0}$
(C) $\frac{\lambda_1\lambda_2}{2\epsilon_0\,\pi a}$ (D) $\frac{\lambda_1\lambda_2}{3\pi a\,\epsilon_0}$

Q.30 In figure $C_1 = 2\mu F$, $C_2 = 6\mu F$ & $C_3 = 3.5\ \mu F$. If break down voltages of the individual capacitors are $V_1 = 100$V, $V_2 = 50$V & $V_3 = 400$V. What maximum voltage can be placed across points a & b-



(A) 124 V (B) 133 V
(C) 100 V (D) 200 V

Q.31 When a free neutron decays to form a proton and an electron, then choose the incorrect statement.

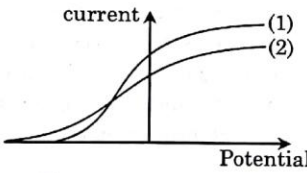
(A) The reaction may be expressed as ${}_0n^1 \rightarrow {}_1p^1 + {}_{-1}e^0$

(B) Every electron comes out with the same energy

(C) The electron shares the major part of the energy released

(D) All the above

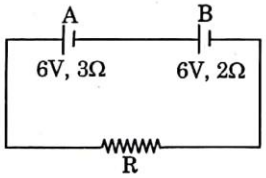
Q.32 When light of intensity I_1 & frequency υ_1 is incident on a substance. Photo electric emission take place and variation potential (V) is as shown by curve (1) in the figure. However, if light of intensity I_2 & frequency υ_2 falls on the same substance, photo electric current varies with potential as shown by curve (2) which of the following is correct -



(A) $I_1 = I_2, \upsilon_1 = \upsilon_2$ (B) $I_1 > I_2, \upsilon_1 > \upsilon_2$

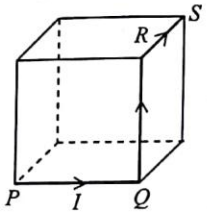
(C) $I_1 > I_2, \upsilon_1 < \upsilon_2$ (D) $I_1 < I_2, \upsilon_1 < \upsilon_2$

Q.33 Two sources of emf 6V and internal resistance 3Ω and 2Ω are connected to an external resistance R as shown. If potential difference across battery A is zero then value of R is -



(A) 1Ω (B) 2Ω (C) 3Ω (D) 4Ω

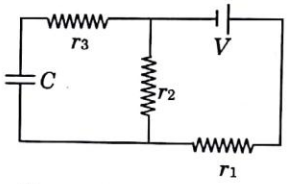
Q.34 A wire $PQRS$ carrying a current I run along three edges of a cube of side ℓ as shown. There exists a uniform magnetic field of magnitude B along one of the sides of the cube. The magnitude of the force acting on the wire is –



(A) Zero (B) $I\ell B$

(C) $\sqrt{2}\, I\ell B$ (D) $2\ell B$

Q.35 In the circuit of following figure, the final voltage drop across the capacitor C is -



(A) $\frac{Vr_1}{r_1 + r_2}$ (B) $\frac{Vr_2}{r_1 + r_2}$

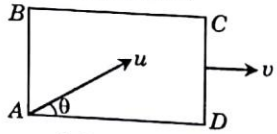
(C) $\frac{V(r_1 + r_2)}{r_2}$ (D) $\frac{V(r_2 + r_1)}{r_1 + r_2 + r_3}$

Q.36 A particle is projected form the ground with an initial velocity of 20 m/s at an angle of 30° with horizontal. The magnitude of change in velocity in a time interval from $t = 0$ to $t = 0.5$ s is ($g = 10$ m/s²)

(A) 5 m/s (B) 2.5 m/s

(C) 2 m/s (D) 4 m/s

Q.37 A smooth square platform $ABCD$ is moving towards right with a uniform speed υ. At what angle θ must a particle be projected from A with speed u so that it strikes the point B?



(A) $\sin^{-1}\left(\frac{u}{\upsilon}\right)$ (B) $\cos^{-1}\left(\frac{\upsilon}{u}\right)$

(C) $\cos^{-1}\left(\frac{u}{\upsilon}\right)$ (D) $\sin^{-1}\left(\frac{\upsilon}{u}\right)$

Q.38 A particle moves in space along the path $z = ax^3 + by^2$ in such a way that $\frac{dx}{dt} = c = \frac{dy}{dt}$ where a, b and c are constants. The acceleration of the particle is -

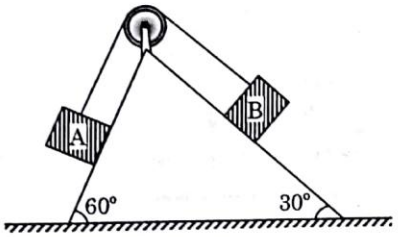
(A) $(6ac^2x + 2bc^2)\hat{k}$ (B) $(2ax^2x + 6by^2)\hat{k}$

(C) $(4bc^2x + 3ac^2)\hat{k}$ (D) $(bc^2x + 2by^2)\hat{k}$

Q.39 A particle moves on a rough horizontal ground with some initial velocity say v_0. If 3/4th of its kinetic energy is lost in friction in time t_0. Then coefficient of friction between the particle and the ground is -

(A) $\frac{v_0}{2gt_0}$ (B) $\frac{v_0}{4gt_0}$ (C) $\frac{3v_0}{4gt_0}$ (D) $\frac{v_0}{gt_0}$

Q.40 Two blocks of equal mass are tied with a light string, which passes over a massless pulley as shown in figure. The magnitude of acceleration of centre of mass of both the blocks is (neglect friction everywhere, inclined wedge is fixed at floor) -



(A) $\left(\frac{\sqrt{3}-1}{4\sqrt{2}}\right)g$ (B) $(\sqrt{3}-1)g$

(C) $\frac{g}{2}$ (D) $\left(\frac{\sqrt{3}-1}{\sqrt{2}}\right)g$

CHEMISTRY

Q.41 The wurtzite structure is described as hcp of S^{2-} ions with the alternate tetrahedral voids occupied by Zn^{2+} ions. A compound containing A, B and X atoms had the A and B atoms arranged as Zn^{2+} and S^{2-} respectively in the hcp lattice. The X atoms occupied alternate octahedral voids. Which of the following is incorrect ?

(A) Formula of the compound is A_2B_2X

(B) Coordination number of A can be 4.

(C) Coordination number of X can be 6.

(D) Centres of 12A atoms lie on the edges of one unit cell.

Q.42 Arrange the following compounds in the increasing order of F–Xe–F bond angle :

XeF_2, XeF_4, XeF_5^-

(A) $XeF_2 < XeF_4 < XeF_5^-$

(B) $XeF_5^- < XeF_4 < XeF_2$

(C) $XeF_2 < XeF_5^- < XeF_4$

(D) $XeF_2 = XeF_4 = XeF_5^-$

Q.43 In which case van't Hoff factor is maximum (assuming no hydrolysis) :

(A) KCl, 50 % ionized

(B) K_2SO_4, 40 % ionized

(C) $FeCl_3$, 30 % ionized

(D) $SnCl_4$, 20 % ionised

Q.44 Which of the following statements is true for azide ion ?

(A) It can acts as bidentate ligand

(B) Two N–N bond lengths aer different in the anion.

(C) It is isoelectronic and isostructural with CO_2

(D) There are two σ and three π bonds.

Q.45 Which does not represent correct method ?

(A) $TiCl_2 + 2Mg \rightarrow Ti + 2MgCl_2$: Kroll

(B) $Ni(CO)_4 \rightarrow Ni + 4CO$: Mond

(C) $Ag_2CO_3 \rightarrow 2Ag + CO_2 + \frac{1}{2}O_2$: Van Arkel

(D) $ZrI_4 \rightarrow Zr + 2I_2$: Van Arkel

Q.46 Which of the following is not correctly matched ?

(A) Sodium (ethylenediaminetetraacetato) chromate(II)-$Na_2[Cr(CH_3COO)]_4$ (en)]

(B) Dichloridobis(ethane-1,2-diamine) cobalt(III) ion-$[Co(Cl)_2(en)_2]^+$

(C) Tris(bipyridyl)iron(II)ion-$[Fe(NH_4–C_5H_4N)_3]^{2+}$

(D) Ammineaquadibromindocopper(II)-$[Cu(NH_3)(H_2O)Br]$

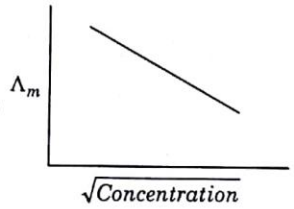
Q.47 S_1 : Melting of Cu(s) is favourable at high temperature and high pressure.

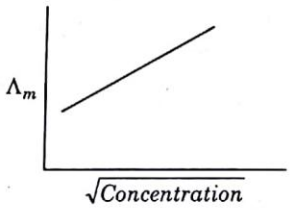
S_2 : Equilibrium $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is stabilished in V(L). If complete equilibrium mixture is transferred to 2V(L) container then the partial pressure of HI will remain same in the new container.

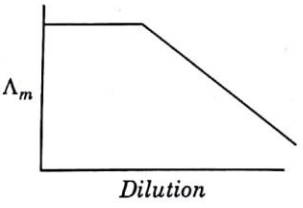
S_3 : Formation of diamond is favourable at very high temperature and very high pressure.

(A) TFF (B) TFT (C) FTT (D) FFT

Q.48 Which of the following plots represent the correct variation of Λ_m of strong electrolyte ?

(A) 

(B) 

(C) 

(D) None of these

Q.49 An aqueous solution contains Al^{3+} & Zn^{2+} both. To this solution NH_4OH is added in excess -

(A) only $Al(OH)_3$ will be precipitated

(B) only $Zn(OH)_2$ will be precipitated

(C) both will be precipitated

(D) no precipitate will appear

Q.50 Which of the following complexes is not correctly matched with their geometries ?

(A) $[CoCl_4]^{2-}$ – tetrahedral

(B) $[Co(PMe_3)_4]$ – tetrahedral

(C) $[Cu(CN)_4]^{3-}$ – tetrahedral

(D) $[Fe(CO)_4]^{2-}$ square planar

Q.51 Which of the following is **INCORRECT** regarding entropy ?

(A) The entropy of solution formed is higher if the detergent concentration is slightly less than CMC as compared to when its concentration is slightly more than CMC.

(B) The vapour pressure of a solution of 10 g protein molecules is expected to be more than that of 10 g urea molecules as entropy of urea solution is more.

(C) The entropy of pure solid solvent is lesser than entropy of pure liquid solvent but equal to entropy of liquid solution of non-volatile solute.

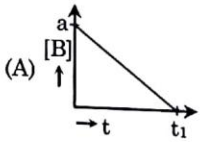
(D) The entropy of colloid molecules decrease on coagulation

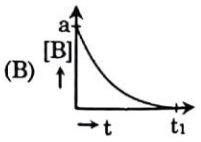
Q.52 In the reaction : $A + 2B \rightarrow$ product

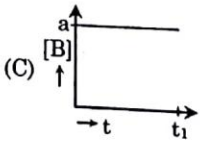
Rate = k [A] $[B]^0$

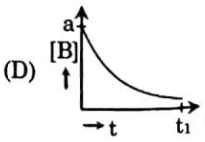
The initial concentration of both A and B are a M. The graph of concentration of B vs time is :

($t_1 = t_{1/2}$ for A)

(A) 

(B) 

(C) 

(D) 

Q.53 Equal volume of two solution having $pH = 2$ and $pH = 10$ are mixed together at 90°C. Then pH of resulting solution is : (Take K_w at 90°C = 10^{-12})

(A) 2 + log 2 (B) 10 – log 2

(C) 7 (D) 6

Q.54 The pair of compounds in which both the compounds give positive test with Tollen's reagent and Fehling solution is -

(A) Propanal and propanone

(B) Propanal and Benzaldehyde

(C) Propanal and 2-Phenylethanal

(D) Benzaldehyde and 1-Hydroxypropanone

Q.55 Which of the following is an optically active polymer -

(A) Nylon 6, 6 (B) Natural rubber

(C) Teflon (D) PVC

Q.56 Isobutyl alcohol and secondary butyl alcohol can be distinguished by -

(A) Oxidatino with alkaline $KMnO_4$ & Tollen's reagent.

(B) Oxidation with acidic dichromate & tollen's reagent

(C) Oxidation by heating with copper followed by reaction with I_2 / $OH^{\ominus}$

(D) Oxidation by concentrated H_2SO_4 followed by reaction with fehling solution

Q.57 (X) $\xrightarrow{NH_3} \xrightarrow{Br_2 / KOH / \Delta} C_6H_7N$ (Aromatic)

(X) cannot be :

(A) Benzoic acid

(B) Benzene carbonyl chloride

(C) Benzoic anhydride

(D) Benzonitrile

Q.58 The correct C–C bond length order is :

$\underset{(x)}{H_3C - CH_3}$ $\underset{(y)}{H_3C - CH_4 - Cl}$

(A) x > y (B) x < y

(C) x = y (D) C – C < C – H

Q.59 The order of acidity of following acids is -

(I) $CH_3–CF_2–COOH$

(II) $CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - COOH$

(III) $CH_3 - \overset{\displaystyle Br}{\overset{|}{\underset{\displaystyle Br}{\underset{|}{C}}}} - COOH$

(IV) $CF_3 - COOH$

(A) I > II > III > IV (B) IV > III > II > I

(C) IV > I > III > II (D) IV > III > I > II

Q.60 Arrange the following compounds in decreasing order of stability -

(I) $CH_2 = CH - CH_2 - HC = CH_2$

(II) $CH_2=CH–CH=CH–CH_3$

(III) 

(A) I > II > III (B) II > I > III

(C) III > II > I (D) III > I > II

BIOLOGY

Q.61 Which layer of the gut is responsible for peristalsis ?

(A) Smooth muscles (B) Mucosa

(C) Submucosa (D) Serosa

Q.62 During muscle fatigue-

(A) Muscle can not relax

(B) Lactic acid deposit in muscle

(C) Blood supply to muscles stop

(D) Nerve supply to muscles become Inactive

Q.63 The correct sequence of arrangements of segments in the leg of cockroach is -

(A) Coxa, femur, trochanter, tibia and tarsus

(B) Coxa, trochanter, femur, tibia and tarsus

(C) Tibia, trochanter, femur, tarsus and coxa

(D) Trochanter, coxa, tibia, femur and tarsus

Q.64 Mark the incorrect statement -

(A) Respiratory centres are found in medulla oblongata

(B) Near lungs Cl^- moves out of the RBC

(C) RBC of deoxygenated blood are slightly bigger than that of oxygenated blood

(D) In polycythemia R.B.Cs are increased in number by amitotic division

Q.65 Condoms are barriers that cover -

(A) Penis in male and ovary in female

(B) Penis in male and cervix and vagina in female

(C) Scrotum in male and cervix and vagina in female

(D) Cervix in male and vagina in female

Q.66 What happens during fertilization in humans after many sperms reach close to the ovum ?

(A) Cells of corona radiate trap all the sperms except one

(B) Only two sperms nearest the ovum prenetrate zona pellucida

(C) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zone pellucida

(D) All sperms except the one nearest to the ovum lose their tails

Q.67 Receptor for protein hormone are found-

(A) On the surface of nucleus

(B) Inside the nucleus

(C) Inside the cytoplasm

(D) On the cell surface

Q.68 Which one of the following is not a phase of the menstrual cycle ?

(A) Luteal phase (B) Estrous phase

(C) Follicular phase (D) Menstrual phase

Q.69 Diphtheria is caused by :

(A) Bordetella (B) Clostridium

(C) Treponema (D) Corynebacteria

Q.70 Saheli, a new oral contraceptive for the females developed by Indian scientists is a :

(A) steroidal preparation

(B) hormonal preparation

(C) non-steroidal preparation

(D) toxic preparation to kill sperms

Q.71 Frequency of an allele in an isolated population may change due to #1

(A) Genetic drift (B) Gene flow

(C) Mutation (D) Natural selection

Q.72 Which evidence of evolution related to Darwin's finches :

(A) Evidences from biogeographical distribution

(B) Evidences from comparative anatomy

(C) Evidences from embryology

(D) Evidences from palaeontological

Q.73 Similarities in organism with different genotype indicates

(A) Microevolution

(B) Macroevolution

(C) Convergent evolution

(D) Divergent evolution

Q.74 The causative agent of mad-cow disease is a-

(A) Bacterium (B) Prion

(C) Worm (D) Virus

Q.75 Roughages include

(A) cereals (B) millets

(C) abundant fibres (D) broken grams

Q.76 Gemmae are asexual buds, which originate from small receptacles called gemma cups. These are found in -

(A) *Funeria* (B) *Marchentia*

(C) *Fern* (D) *Sphagnum*

Q.77 Cycads are -

(A) Homosporous and dioecious

(B) Homosporous and monoeciuous

(C) Heterosporous and dioecious

(D) Heterosporous and monoeciuous

Q.78 Which one is the correct statement about the bacterial cell envelope ?

(A) The outermost cell wall is followed by glycocalyx and then the plasma membrane

(B) Cell envelope is chemically very simple and consists of only plasma membrane

(C) The outermost glycocalyx is followed by cell wall and plasma membrane

(D) The outermost glycocalyx is followed by plasma membrane and then the cell wall

Q.79 Select the correct statements regarding S-phase of interphaser.

I. Occurs between G_1 and G_2

II. DNA replication begins in the nucleus

III. Centrioles duplicate in the cytiplasm

IV. As DNA is doubled, number of chromosomes also

The option with correct statements is -

(A) IV and III (B) I, II, III and IV

(C) II, III and IV (D) I, II and III

Q.80 Absorption spectrum of chlorophyll-a and the action spectrum of photosynthesis is identical because chlorophyll-a -

(A) Absorbs the maximum light

(B) Absorbs the minimum light

(C) Absorbs the red and blue light

(D) Is found most abundantly

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 $2\,f(xy) = (f(x))^y + (f(y))^x$ & $f(1) = k$ then $\sum_{r=1}^{n} f(r) =$

(A) $k^n - 1$ (B) k^n

(C) $k^n + 1$ (D) None of these

Q.82 If $f(x) = \left([\{x\}]\tan^{-1}\left(\frac{x^2-3x-1}{x^2-3x+5}\right)+3-x^7\right)^{1/7}$,

where $[k]$ and $\{k\}$ denotes greatest integer and fractional part functions of k respectively, then the value of $f^{-1}(50) + f(f(100)) - f(50)$, is-

(A) 0 (B) 25

(C) 50 (D) 100

Q.83 The sum to n terms of the series, $1 + \left(1+\frac{1}{2}+\frac{1}{2^2}\right)+\left(1+\frac{1}{2}+\frac{1}{2^2}+\frac{1}{2^3}+\frac{1}{2^4}\right)+$ ..... is -

(A) $2n-\frac{4}{3}\left\{1-\frac{1}{2^{2n}}\right\}$ (B) $2n+\frac{4}{3}\left\{1-\frac{1}{2^{2n}}\right\}$

(C) $2n+\frac{4}{3}\left\{1+\frac{1}{2^{2n}}\right\}$ (D) None of these

Q.84 Sum to n terms

$$\left[\frac{1}{1.3}+\frac{2}{1.3.5}+\frac{3}{1.3.5.7}+\frac{4}{1.3.5.7.9}+\ldots\ldots\right]$$

is-

(A) $\frac{1}{2}\left[1+\frac{1}{1.3.5.\ldots\ldots(2n+1)}\right]$

(B) $\frac{1}{2}\left[1-\frac{1}{2.4.6.\ldots\ldots 2n}\right]$

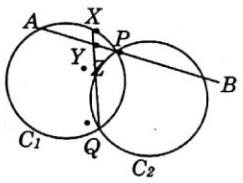
(C) $\frac{1}{2}\left[1-\frac{1}{1.3.5.\ldots\ldots(2n+1)}\right]$

(D) None of these

Q.85 If $\cos\alpha$, $\cos\beta$ and $\cos\gamma$ are the roots of the equation $9x^3 - 9x^2 - x + 1 = 0$, $\alpha, \beta, \gamma \in [0, \pi]$, then radius of the circle whose centre is $(\sum\alpha, \sum\cos\alpha)$ and passing through $\left(2\sin^{-1}\left(\tan\frac{\pi}{4}\right), 4\right)$ is -

(A) 3 (B) 9 (C) 4 (D) 6

Q.86 Two circles C_1 and C_2 intersect at two distinct points P & Q in a plane. Let a line passing through P meets circle C_1 & C_2 in A and B respectively. Let Y is mid point of AB and QY meets circle C_1 and C_2 in X and Z respectively, then-



(A) Y is trisection point of XZ

(B) $\frac{XY}{YZ} = \frac{3}{1}$

(C) $XY = YZ$

(D) $XY + YZ = 3YZ$

Q.87 Number of values of x for which $\frac{8^x + 27^x}{12^x + 18^x} = \frac{7}{6}$ is-

(A) 2 (B) 3

(C) 1 (D) no value of x

Q.88 The most general values of x for which $\sqrt{3}\sin x - \cos x = \min_{\lambda\in R}\{2, e^2, \pi, \lambda^2 - 4\lambda + 7\}$ are given by -

(A) $2n\pi$ (B) $2n\pi + \frac{2\pi}{3}$

(C) $n\pi + (-1)^n\frac{\pi}{4} + \frac{\pi}{6}$ (D) $n\pi + (-1)^{n+1}\frac{\pi}{4} - \frac{\pi}{3}$

Q.89 Given that the vectors $\vec{a}$ and $\vec{b}$ are non collinear, the values of x and y for which the vector equality $2\vec{u} - \vec{v} = \vec{w}$ holds true if $\vec{u} = x\vec{a} + 2y\vec{b}$, $\vec{v} = -2y\vec{a} + 3x\vec{b}$, $\vec{w} = 4\vec{a} - 2\vec{b}$ are -

(A) $x = \frac{4}{7}, y = \frac{6}{7}$ (B) $x = \frac{10}{7}, y = \frac{4}{7}$

(C) $x = \frac{8}{7}, y = \frac{2}{7}$ (D) $x = 2, y = 3$

Q.90 Solution of the equation $x^3\frac{dy}{dx} + 4x^2\tan y = e^x\sec y$ when $y(1) = 0$ is -

(A) $\sin y = e^x(x-1)x^{-4}$

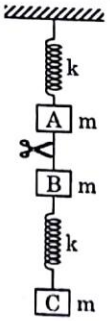
(B) $\sin y = e^x(x-1)x^{-3}$

(C) $\tan y = e^x(x-1)x^{-3}$

(D) $\tan y = e^x(x-2)\log x$

PHYSICS

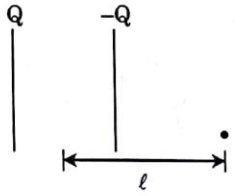
Q.91 The spring block system as shown in figure is in equilibrium. The string connecting blocks A and B is cut. The mass of all the three blocks is m and spring constant of both the spring is k. The amplitude of resulting oscillation of block A is (string massless)



(A) $\frac{mg}{k}$ (B) $\frac{2mg}{k}$

(C) $\frac{3mg}{k}$ (D) $\frac{4mg}{k}$

Q.92 The plates of small size of a parallel plate capacitor are charged as shown. The force on the charged particle of 'q' at a distance 'ℓ' from the capacitor is : (Assume that the distance between the plates is $d << \ell$)



(A) zero (B) $\frac{Qqd}{2\pi \epsilon_0 \ell^3}$

(C) $\frac{Qqd}{\pi \epsilon_0 \ell^3}$ (D) $\frac{Qqd}{4\pi \epsilon_0 \ell^3}$

Q.93 A charged particle of specific charge (charge/mass) α is the projected from origin with a velocity $\vec{u} = v_0(\hat{i} + \hat{j})$ in a uniform and constant magnetic field $\vec{B} = B_0\hat{i}$. The position co-ordinates of the particle at time $t = \frac{\pi}{B_0\alpha}$ are -

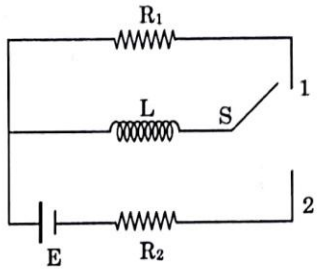
(A) $\left(\frac{v_0}{2B_0\alpha}, \frac{\sqrt{2}v_0}{\alpha B_0}, \frac{-v_0}{B_0\alpha}\right)$

(B) $\left(-\frac{v_0}{2B_0\alpha}, 0, 0\right)$

(C) $\left(0, \frac{2v_0}{B_0\alpha}, \frac{v_0\pi}{2B_0\alpha}\right)$

(D) $\left(\frac{v_0\pi}{B_0\alpha}, 0, \frac{-2v_0}{B_0\alpha}\right)$

Q.94 In the circuit shown switch S is connected to position 2 for a long time and then joined to position 1. The total heat produced in resistance R_1 is -



(A) $\frac{LE^2}{2R_2^2}$ (B) $\frac{LE^2}{2R_1^2}$

(C) $\frac{LE^2}{2R_1R_2}$ (D) $\frac{LE^2(R_1+R_2)^2}{2R_1^2R_2^2}$

Q.95 Current in an ac circuit is given by $i = 3\sin\omega t + 4\cos\omega t$ then -

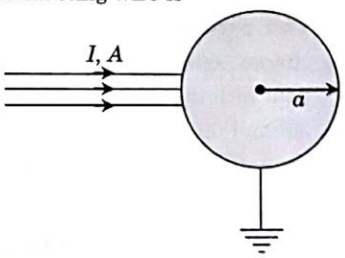
(A) rms value of current is 5 A

(B) mean value of this current in one half period will be $6/\pi$.

(C) if voltage applied is $V = V_m \sin\omega t$ then the circuit must be containing resistance and capacitance.

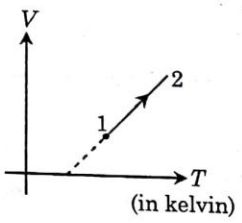
(D) If voltage applied is $V = V_m \sin\omega t$, the circuit may contain only resistance and inductance

Q.96 A parallel beam of monochromatic radiation of cross-section area $A(< \pi a^2)$, intensity I and frequency ν is incident on a solid conducting sphere of work function ϕ_0 [$h\nu > \phi_0$] and radius 'a'. The sphere is grounded by a conducting wire. Assume that for each incident photon one photoelectron is ejected. Just after this radiation is incident on initially uncharged sphere, the current through the conducting wire is -



(A) $\frac{IAe}{h\nu}$ (B) $\frac{IAe}{2h\nu}$ (C) $\frac{2IAe}{h\nu}$ (D) None

Q.97 V–T diagram for a process of a given mass of ideal gas is as shown in the figure. During the process pressure of gas.



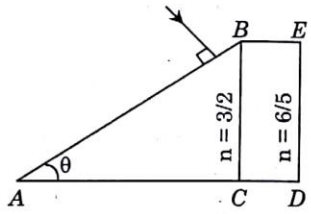
(A) first increases then decreases

(B) continuously decreases

(C) continuously increases

(D) first decreases then increases

Q.98 In the figure *ABC* is the cross section of a right angled prism and *BCDE* is the cross section of a glass slab. The value of θ so that light incident normally on the face AB does not cross the face *BC* is (given $\sin^{-1}(3/5) = 37°$)



(A) $\theta \le 37°$ (B) $\theta < 37°$

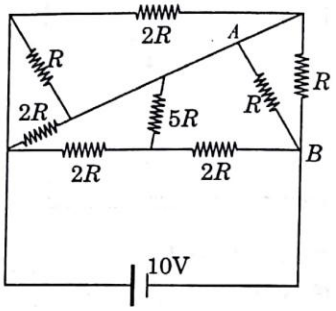
(C) $\theta \le 53°$ (D) $\theta < 53°$

Q.99 Two particles having the same specific charge (q/m) enter a uniform magnetic field with the same speed but an angles of 30° and 60° with the field. Let *a*, *b* and *c* be ratios of their pitches, radii and periods of their paths respectively, then -

(A) $a + b = 2\sqrt{c}$ (B) $abc = 1$

(C) $a^2 = c$ (D) $ab^2 = c$

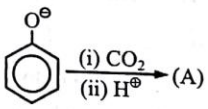
Q.100 In the given electrical circuit, the potential difference between points *A* and *B* is (assume the battery is ideal and the conducting wires have almost zero resistance).



(A) 5 V (B) 10 V

(C) 25 V (D) 70 V

CHEMISTRY

Q.101 

Which of the following is true statement about the reaction ?

(A) o– isomer is major if PhONa is used

(B) p–isomer is major if PhOK is used

(C) Product formed is further used for preparation of drug Asprin

(D) All of these

Q.102 A compound with molecular formula $C_4H_{10}O_3$ is converted by the action of acetyl chloride to a compound of molecular mass 190 the original compound ($C_4H_{10}O_3$) has -

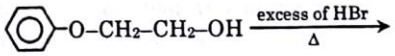
(A) Two – OH groups

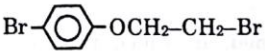
(B) four – OH groups

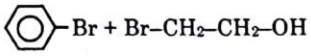
(C) One OH group

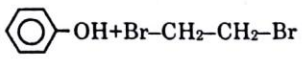
(D) Three– OH groups

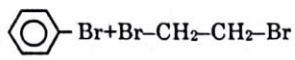
Q.103 What are the products of the following reaction ?



(A) 

(B) 

(C) 

(D) 

Q.104 **Statement I :** R-1-bromo-1-fluoro ethane reacts with MeONa to give S-1-fluoro-1-methoxy ethane.

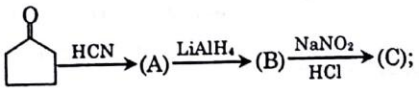
Statement II : Walden inversion takes place during S_{N^2} reaction.

(A) Statement-I is true, statement-II is true & statement-II is not the correct explanation for statement-I

(B) Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I

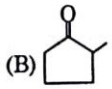
(C) Statement-I is false, statement-II is true

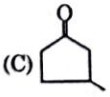
(D) Statement-I is true, Statement-II is false

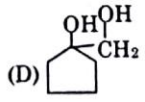
Q.105 

End product (C) in above reaction is -

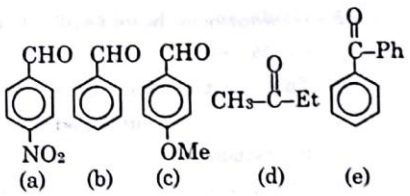
(A) 

(B) 

(C) 

(D) 

Q.106 The correct order of rate of reaction towards Nucleophilic addition reaction -



(a) (b) (c) (d) (e)

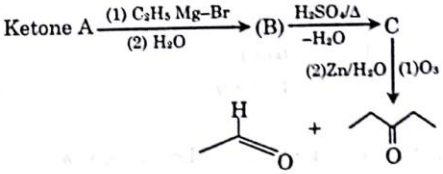
(A) a > b > c > d > e

(B) a > b > d > c > e

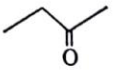
(C) a > d > e > b > c

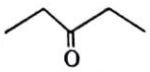
(D) a > b > e > d > c

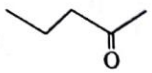
Q.107 Consider the following sequence of reactions -



The Ketone (A) is -

(A) 

(B) 

(C) 

(D) 

Q.108 The pair in which both species have same magnetic moment (spin only value) is -

(A) $[Cr(H_2O)_6]^{2+}$, $[COCl_4]^{2-}$

(B) $[Cr(H_2O)_6]^{2+}$, $[CoF_6]^{3-}$

(C) $[Mn(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{2+}$

(D) $[COCl_4]^{2-}$, $[Fe(H_2O)_6]^{2+}$

Q.109 The 'brown ring' formed at the junction of two layers in the test of nitrate is due to the formation of a complex ion, $[Fe(H_2O)_5NO]^{2}$. Which of the following statements are correct for this complex [μ = 3.87 B.M.] -

(I) Oxidation state of Fe is +1 and NO exists as NO^+

(II) The complex ion is in octahedral geometry as attained by sp^3d^2 hybridisation

(III) The complex is paramagnetic and has three unpaired electrons due to transfer of electron from NO to Fe^{2+}

(IV) The complex is octahedral geometry as attained by d^2sp^3 hybridisation

(V) The brown colour of the complex is attributed to d-d-transition of electron

(A) I, II and V

(B) III, IV and V

(C) I, II and III

(D) II, III and V

Q.110 Which of the following gives Cannizaro reaction -

(A) $CH_3-CH_2-\underset{\underset{O}{\|}}{C}-H$

(B) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$

(C) $C_6H_5-CH_2-\underset{\underset{O}{\|}}{C}-H$

(D) $CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{\underset{O}{\|}}{C}-H$

BIOLOGY

Q.111 Which of the following true for ETS in eukaryotes-

(A) It produces $NADH.H^+$ & $FADH.H^+$

(B) It takes place in outer surface of inner membrane of mitochondria.

(C) It directly generates ATP

(D) Up hill transport of proton across inner membrane of mitochondria is due to active transport during ETS.

Q.112 In Antirrhinum majus, the Red (RR) flowered plant crossed with white flowered (rr) plant & in F_1 generation pink (Rr) flowered plants obtained on selfing of F_1 generation, F_2 generation obtained. In which the ratio of Red & white flowered plants will -

(A) 2 : 1 (B) 3 : 1

(C) 1 : 2 (D) 1 : 1

Q.113 If the sequence of coding strand of DNA is 5'–ATG CTC GTA 'AA3' what will the sequence of newly formed m-RNA on this DNA -

(A) 5'-AUG CUG GUG CAB3'

(B) 3'-AUG CUG GUG CAA5'

(C) 5'-UAC GAG CAC GUU3'

(D) 3'-AUU CAC GAG UAC

Q.114 Nepenthes is insectivorous plant. It is considered as -

(A) Producer

(B) Primary consumer

(C) Secondary consumer as well as producer

(D) Primary producer as well as secondary producer

Q.115 The fruit of Mango is drupe and its edible part is -

(A) Epicarp

(B) Mesocarp

(C) Endocarp

(D) Endosperm & Epicarp

Q.116 Mouth becomes watery when we look on the delicious food is due to -

(A) Olfactory response

(B) Hormonal response

(C) Neural response

(D) Optic response

Q.117 Signals for parturition originate from -

(A) Both placenta as well as fully developed foetus

(B) Oxytocin released from maternal pituitary

(C) Placenta only

(D) Fully developed foetus only

Q.118 Which was not given by Darwin ?

(A) Variations

(B) Natural selection

(C) Survival of the fittest

(D) Struggle for existence

Q.119 Cholera patient is administrated by 'saline drip' because -

(A) Na^+ ions are essential for the transport of substances across the membrane

(B) Na^+ ions are helpful to conserving water in the body.

(C) Cl^- ions are helpful in the formation HCl for digestion.

(D) Cl^- ions is significant component of blood plasma

Q.120 When a freshwater protozoan possessing a contractile vacuole, is placed in a glass containing marine water, the vacuole will -

(A) increase in size

(B) disappear

(C) decrease in size

(D) increase in number

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-6

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 Let $f(x) = \int_0^x \cos\left(\frac{t^2+2t+1}{5}\right) dt$, $0 < x < 2$.

Then $f(x)$ -

(A) increases monotonically

(B) decreases monotonically

(C) has one point of local maximum

(D) has one point of local minimum

Q.2 The mean of 20 observations is 15. On checking it was found that the two observations were wrongly copied as 3 & 6. The correct values are 8 and 4, then correct mean will be given by:

(A) 15.15 (B) 14.69

(C) 14.74 (D) 15.25

Q.3 If $f(x) = [x] + [x + 1/3] + [x + 2/3]$, then ([.] denotes the greatest integer function)-

(A) $f(x)$ is continuous at $x = 1, 10, 15$

(B) $f(x)$ is continuous at $x = n/3$, where n is any integer

(C) $\int_0^{2/3} f(x)dx = 1/3$

(D) $\lim_{x \to 2/3} f(x) = 2$

Q.4 The area of the domain of the function $f(x, y) = \sqrt{16-x^2-y^2} - \sqrt{|x|-y}$ is $k\pi$, where k equals-

(A) 8 (B) 9 (C) 4 (D) 12

Q.5 If A is order 4 square matrix such that $|A| = 2$, then $|\text{adj}(\text{adj}(\text{adj}\, A))|$ is-

(A) 512 (B) 256

(C) 64 (D) None of these

Q.6 If α is a real root of the equation

$x^2 + 3x - \tan\left(\frac{1}{2}\right) = 0$, then $\cot^{-1}\alpha + \cot^{-1}\frac{1}{\alpha} - \frac{\pi}{2}$ is equal to-

(A) 0 (B) $\frac{\pi}{2}$ (C) π (D) $\frac{3\pi}{2}$

Q.7 If α and β are the roots of the equation $ax^2 + bx + c = 0$, $(a, b, c \in R)$ then - $(1 + \alpha + \alpha^2)(1 + \beta + \beta^2)$, is -

(A) < 0 (B) > 0

(C) $= 0$ (D) None of these

Q.8 If the fraction $\frac{x^3+(a-10)x^2-x+a-6}{x^3+(a-6)x^2-x+a-10}$ reduces to a quotient of two linear functions then a -

(A) 6 (B) 8 (C) 4 (D) 2

Q.9 If $x \in \left(\frac{3\pi}{2}, 2\pi\right)$ then value of the expression $\sin^{-1}(\cos(\cos^{-1}(\cos x) + \sin^{-1}(\sin x)))$ equals -

(A) $-\frac{\pi}{2}$ (B) $\frac{\pi}{2}$

(C) 0 (D) None of these

Q.10 If $a = \log_3 \log_3 2$. An integer r satisfying $1 < 2^{(-r+3^{-a})} < 2$ must be less than -

(A) -1 (B) 0 (C) 1 (D) 2

Q.11 The set of integer values of x satisfying $\frac{\left(2^{\frac{\pi}{\tan^{-1}x}} - 4\right)(x-4)(x-10)}{x!-(x-1)!} < 0$ is-

(A) {2, 3} (B) {5, 6, 7, 8, 9}

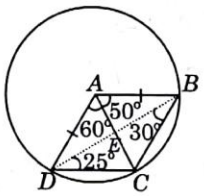
(C) ϕ (D) None of these

Q.12 If $\frac{a+b}{1-ab}$, b, $\frac{b+c}{1-bc}$ are in A.P. then a^{-1}, b, c^{-1} are in–

(A) A.P. (B) G.P.

(C) H.P. (D) None of these

Q.13 Let $ABCD$ is a convex quadrilateral in which $\angle BAC = 50°$, $\angle CAD = 60°$, $\angle CBD = 30°$ & $\angle BDC = 25°$. If E is the point of intersection of AC & BD then $\angle AEB$ equals -



(A) 65° (B) 75° (C) 85° (D) 95°

Q.14 If $\sin^3\theta + \sin\theta\cos\theta + \cos^3\theta = 1$, then x is equal to $(n \in Z)$ -

(A) $2n\pi - \frac{\pi}{4}$ (B) $2n\pi + \frac{\pi}{2}$

(C) $2n\pi - \frac{\pi}{2}$ (D) $n\pi$

Q.15 $\frac{\tan 3x}{\tan x}$ never lies between -

(A) 2 and $\frac{1}{2}$ (B) 3 and $\frac{1}{3}$

(C) 4 and $\frac{1}{4}$ (D) 5 and $\frac{1}{5}$

Q.16 Equation of the image of the line $x+y=\sin^{-1}(a^3+1)+\cos^{-1}(a^2+1)-\tan^{-1}(a+1)$, $a \in R$ about y-axis is given by-

(A) $x-y+\frac{\pi}{4}=0$ (B) $x-y=0$

(C) $x-y=\frac{\pi}{4}$ (D) $x-y=\frac{\pi}{2}$

Q.17 If $0 \le \arg(z) \le \frac{\pi}{4}$, then the least value of $\sqrt{2}\,|2z-4i|$ is -

(A) 6 (B) 1 (C) 4 (D) 2

Q.18 Let $\vec{b}=4\hat{i}+3\hat{j}$ and $\vec{c}$ be two vectors perpendicular to each other in the xy-plane. Then a vector in the same plane have projection 1 and 2 along $\vec{b}$ and $\vec{c}$ respectively, is -

(A) $\hat{i}+2\hat{j}$ (B) $2\hat{i}-\hat{j}$

(C) $2\hat{i}+\hat{j}$ (D) None of these

Q.19 Let $\vec{a},\vec{b},\vec{c}$ are three non-coplanar vectors such that $\vec{r_1}=\vec{a}-\vec{b}+\vec{c}$, $\vec{r_2}=\vec{b}+\vec{c}-\vec{a}$, $\vec{r_3}=\vec{c}+\vec{a}-\vec{b}$, $\vec{r}=2\vec{a}-3\vec{b}+4\vec{c}$ if $\vec{r}=\lambda_1\vec{r_1}+\lambda_2\vec{r_2}+\lambda_3\vec{r_3}$ then -

(A) $\lambda_1=7$ (B) $\lambda_1+\lambda_3=3$

(C) $\lambda_1+\lambda_2+\lambda_3=3$ (D) None of these

Q.20 Solution of the differential equation $x\,dy-y\,dx-\sqrt{x^2+y^2}\,dx=0$ is -

(A) $y-\sqrt{x^2+y^2}=Cx^2$

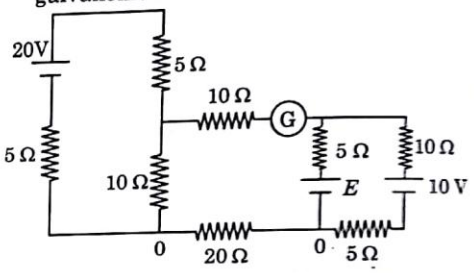
(B) $y+\sqrt{x^2+y^2}=Cx^2$

(C) $x+\sqrt{x^2+y^2}=Cy^2$

(D) $x-\sqrt{x^2+y^2}=Cy^2$

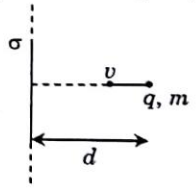
PHYSICS

Q.21 What should be value of E for which galvanometer shows no deflection :



(A) 10 V (B) 5V (C) 15 V (D) 20 V

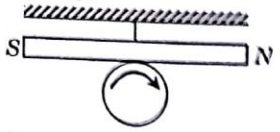
Q.22 The particle of mass m and charge q will touch the infinitely large plate of uniform charge density σ if its velocity v is more than : (Given that $\sigma q > 0$)



(A) 0 (B) $\sqrt{\frac{2\sigma qd}{m\,\epsilon_0}}$

(C) $\sqrt{\frac{\sigma qd}{m\,\epsilon_0}}$ (D) none of these

Q.23 A negative charge is given to a loop and the loop is rotated in the plane of paper about its centre as shown. The magnetic field produced by the ring affects a small magnet placed above the ring in the same plane of paper.



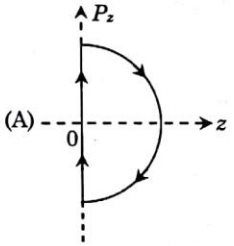
(A) the magnet does not rotate

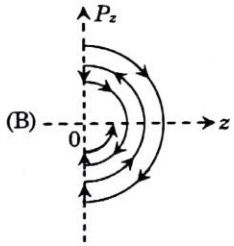
(B) the magnet rotates clockwise as seen by observer from below

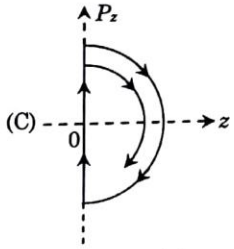
(C) the magnet rotates anti-clockwise as seen from below

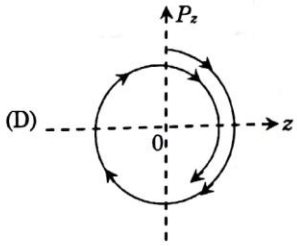
(D) none of the above

Q.24 An inelastic ball of mass m has been thrown vertically upwards (positive z-direction) from the ground at $z = 0$. Linear momentum of ball is P_z. The phase trajectory (graph between P_z versus z) of the ball after successive bouncing on the ground is-

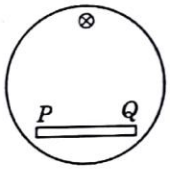
(A) 

(B) 

(C) 

(D) 

Q.25 In a cylindrical region uniform magnetic field which is perpendicular to the plane of the figure is increasing with time and a conducting rod PQ is placed in the region. Then -



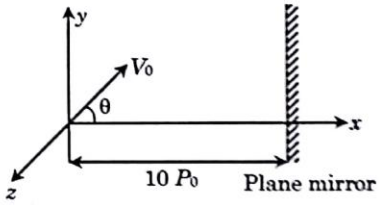
(A) P will be at higher potential than Q.

(B) Q will be at higher potential than P.

(C) Both P and Q will be equipotential

(D) no emf will be developed across rod as it is not crossing / cutting any line of force

Q.26 In the plane mirror, the co-ordinates of image after two and half time periods are (initial velocity V_0 is in the xy-plane and the plane mirror is perpendicular to the x-axis. A uniform magnetic field $B\hat{i}$ exists in the whole space. P_0 is pitch of helix, R_0 is radius of helix).



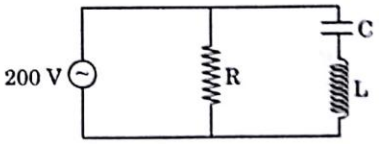
(A) $17P_0, 0, -2R_0$

(B) $3P_0, 0, -2R_0$

(C) $17.5\ P_0, 0, -2R_0$

(D) $3P_0, 0, 2R_0$

Q.27 In the circuit diagram shown, $X_C = 100\Omega$, $X_L = 200\ \Omega$ & $R = 100\Omega$. The effective current through the source is -



(A) 2A (B) $2\sqrt{2}$ A

(C) 0.5 A (D) $\sqrt{0.4}$ A

Q.28 In a YDSE both slits produce equal intensities on the screen. A 100 % transparent thin film is placed in front of one of the slits. Now the intensity of the geometrical centre of system on the screen becomes 75 % of the previous intensity. The wavelength of the light is 6000 Å and $\mu_{film} = 1.5$. The thickness of the film cannot be -

(A) 0.2 μm (B) 1.0 μm

(C) 1.4 μm (D) 1.6 μm

Q.29 If we assume that penetrating power of any radiation/particle is inversely proportional to its De-broglie wavelength of the particle then -

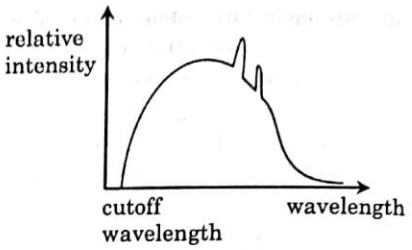
(A) a proton and an α-particle after getting accelerated through same potential difference will have equal penetrating power.

(B) penetrating power of α-particle will be greater than that of proton which have been accelerated by same potential difference.

(C) proton's penetrating power will be less than penetrating power of an electron which has been accelerated by the same potential difference.

(D) penetrating powers can not be compared as all these are particles having no wavelength or wave nature.

Q.30 A beam of electrons striking a copper target produces x-rays. Its spectrum is as shown. Keeping the voltage same if the copper target is replaced with a different metal, the cut-off wavelength and characteristic lines of the new spectrum will change in comparison with old as -



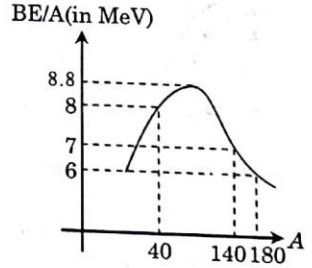
(A) Cut-off wavelength will remain unchanged while characteristic lines will be different.

(B) Both cut-off wavelength and characteristic lines will remain unchanged.

(C) Both cut-off wavelength and characteristic lines will be different.

(D) Cut-off wavelength will different while characteristic lines will remain unchanged.

Q.31 A heavy nucleus x(A = 180) breaks into two nuclie y (A = 140) and z (A = 40). Energy released during fission reaction is -



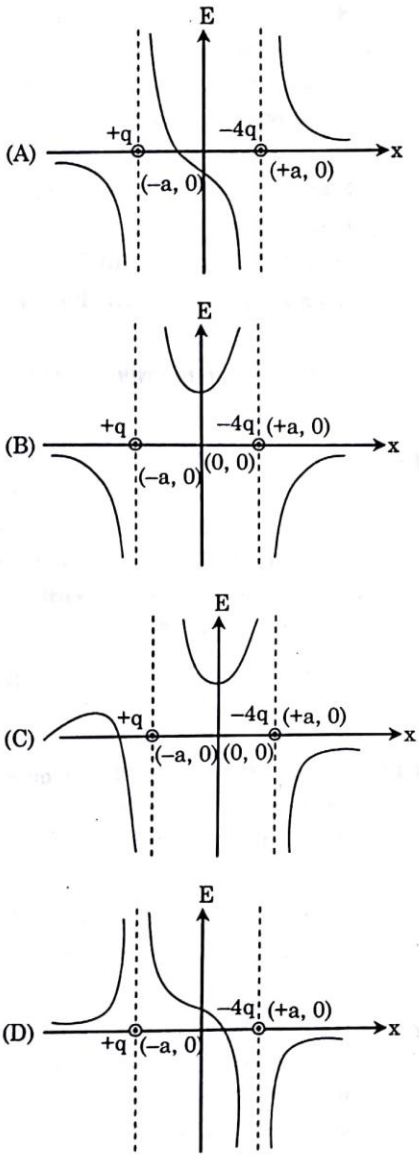
(A) 110 MeV

(B) 220 MeV

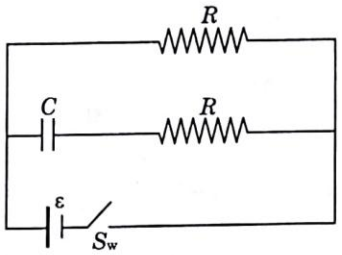
(C) 200 MeV

(D) Energy is not released

Q.32 Two point charges +q and –4q are placed at (–a, 0) and (+a, 0). Take electric field intensity to be positive if it is along positive x-direction. The variation of the electric field intensity as one moves along the x-axis is -



Q.33 If at t = 0 the switch S_w is closed, then the charge on capacitor in the given circuit (initially uncharged) when the current through battery becomes 50 % of its maximum value is (assume battery is ideal).



(A) $\frac{C\varepsilon}{3}$ (B) $\frac{C\varepsilon}{2}$ (C) $\frac{C\varepsilon}{4}$ (D) $C\varepsilon$

Q.34 Two rods of same length and areas of cross section A_1 and A_2 have their ends at same temperature. If K_1 and K_2 are their thermal conductivities, C_1 and C_2 their specific heats and ρ_1 and ρ_2 are their densities, then the condition that rate of flow of heat is same in both the rods is -

(A) $A_1/A_2 = K_1/K_2$

(B) $A_1/A_2 = K_1C_1\rho_1/K_2C_2\rho_2$

(C) $A_1/A_2 = K_2C_1\rho_1/K_1C_2\rho_2$

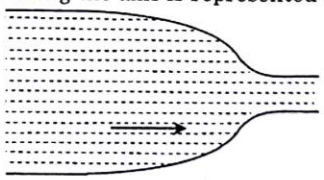
(D) $A_1/A_2 = K_2/K_1$

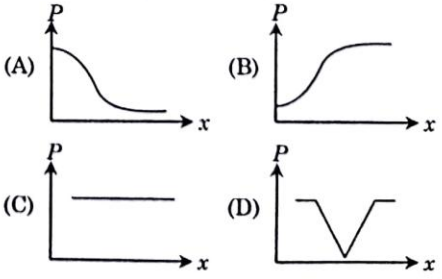
Q.35 A chord attached about an end to a vibrating fork 'divides it into 6 loops, when its tension is 36 N. The tension at which it will vibrate in 4 loops is -

(A) 24 N (B) 36 N

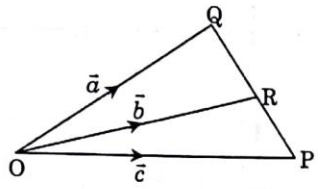
(C) 64 N (D) 81 N

Q.36 Water flows through a frictionless horizontal duct with a cross-section varying as shown in figure. Pressure P at points along the axis is represented by -





Q.37 Figure shows three vectors $\vec{a}$, $\vec{b}$ & $\vec{c}$. If $RQ = 2PR$, which of the following relations is correct ?



(A) $2\vec{a} + \vec{c} = 3\vec{b}$ (B) $\vec{a} + 3\vec{c} = 2\vec{b}$

(C) $3\vec{a} + \vec{c} = 2\vec{b}$ (D) $\vec{a} + 2\vec{c} = 3\vec{b}$

Q.38 A pebble is thrown horizontally from the top of a 20 m high tower with an initial velocity of 10 m/s. The air drag is negligible. The speed of the pebble when it is at the same distance from top as well as base of the tower ($g = 10$ m/s^2)

(A) $10\sqrt{2}$ m/s (B) $10\sqrt{3}$ m/s

(C) 20 m/s (D) 25 m/s

Q.39 Two bodies A and B have emissivities 0.5 and 0.8 respectively. At some temperatures the two bodies have maximum spectral emissive powers at wavelegnth 8000 Å and 4000 Å respectively. The ratio of their emissive powers at these temperatures are -

(A) $\frac{5}{128}$ (B) 10

(C) $\frac{5}{16}$ (D) none of these

Q.40 Consider the following statements :

S_1 : An uncharged conductor kept near a charged body is attracted by that body whether the charge on the body is positive or negative.

S_2 : A solid conductor is placed in a uniform electric field. The electric field due to conductor will be same at every point inside the conductor.

S_3 : The electric field produced by an infinitely large sheet is same on both sides.

S_4 : Intensity of electric field decreases as you go away from the centre of a uniformly charged solid sphere (having uniform volume charge density).

State, in order, whether S_1, S_2, S_3, S_4 are true or false.

(A) F T F T (B) T F T F

(C) F F T F (D) T T F F

CHEMISTRY

Q.41 1 mol of N_2 and 4 mol of H_2 are allowed to react in a vessel and after reaction, H_2O is added. Aqueous solution required 1 mol of HCl for neutralization. Mol fraction of H_2 in the remaining gaseous mixture after reaction is - #1

(A) $\frac{1}{6}$ (B) $\frac{5}{6}$ (C) $\frac{1}{3}$ (D) none

Q.42 In ground state of P if four quantum no. are (4, 1, 0, – 1/2) (for last e$^-$) then calculate the quantum no. of last e$^-$ in excited state of P –

(A) 4, 2, 0, + 1/2 (B) 4, 2, + 1, + 1/2

(C) 4, 2, – 1, – 1/2 (D) All are correct

Q.43 0.3 g of an oxalate salt was dissolved in 100 mL solution. The solution required 90 mL of N/20 $KMnO_4$ for complete oxidation. The % of oxalate ion in salt is -

(A) 33% (B) 66%

(C) 70% (D) 40%

Q.44 The vapour pressure of water at room temperature is lowered by 5% by dissolved a solute in it. What is approximate molality of solution ?

(A) 2 (B) 1 (C) 4 (D) 3

Q.45 Correct order of second I.E. is -

(A) $Li < Be < B < C < N < O < F < Ne$

(B) $Li < B < Be < C < O < N < F < Ne$

(C) $Be < C < B < N < F < O < Ne < Li$

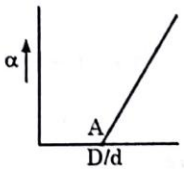
(D) $B < Li < C < Be < N < O < Ne < F$

Q.46 An equilibrium mix. contains N_2O_4 & NO_2 at 0.28 & 1.1 atm. resp. at 300K. If volume of container is doubled, calculate new equilibrium pressure of NO_2

(A) 0.095 atm (B) 0.64 atm

(C) 1.1 atm (D) 0.28 atm

Q.47 In the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ If D & d are the vapour densities at initial stage & at equilibrium then what will be the value of $\frac{D}{d}$ at point A in the following graph ?



(A) 0 (B) 1.5 (C) 1 (D) 0.5

Q.48 The decomposition of azo methane, at certain temperature according to the equation $(CH_3)_2N_2 \rightarrow C_2H_6 + N_2$ is a first order reaction. After 40 minutes from the start, the total pressure developed is found to be 350 mm Hg in place of initial pressure 200 mm Hg of azo methane. The value of rate constant k is -

(A) 2.88×10^{-4} sec^{-1} (B) 1.25×10^{-4} sec^{-1}

(C) 5.77×10^{-4} sec^{-1} (D) None of these

Q.49 500 ml of 0.2 M BOH (weak base) is mixed with 500 ml of 0.1 M HCl. Resulting buffer has pH = 9. What will be the pH of 0.1 M BCl solution -

(A) 1 (B) 3 (C) 5 (D) 9

Q.50 Which of the following process are associated with the change of hybridization of the under lined compound ?

(a) Al(OH) ppt. dissolved in NaOH

(b) B_2H_6 is dissolved in THF

(c) SiF_4 vapour is passed through liq. HF

(d) Solidification of PCl_5 vapour

(A) a, b, c (B) a, b, d

(C) a, c, d (D) only d

Q.51 Arrange the following in the decreasing order of their bond angles -

(A) $NH_3 > NF_3 > PF_3 > PH_3$

(B) $NH_3 > PF_3 > NF_3 > PH_3$

(C) $NF_3 > NH_3 > PH_3 > PF_3$

(D) $NH_3 > PH_3 > NF_3 > PF_3$

Q.52 On vigorous oxidation by permanganate solution $(CH_3)_2C = CHCH_2CHO$ gives

(A) $(CH_3)_2CO$ and $OHCCH_2CHO$

(B) $(CH_3)_2\underset{OH}{C}—\underset{OH}{CH}CH_2CHO$

(C) $(CH_3)_2CO$ and $OHCCH_2COOH$

(D) $(CH_3)_2CO$ and $CH_2(COOH)_2$

Q.53 3-phenylpropene on reaction with HBr gives (as a major product)

(A) $C_6H_5CH_2CH(Br)CH_3$

(B) $C_6H_5CH(Br)CH_2CH_3$

(C) $C_6H_5CH_2CH_2Br$

(D) $C_6H_5CH(Br)CH=CH_2$

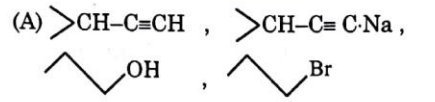
Q.54 In this sequence of reactions -

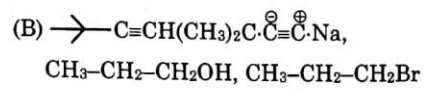
$$P \xrightarrow{NaNH_2/NH_2} Q$$

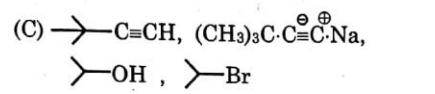
$$R \xrightarrow[\Delta]{HBr} S$$

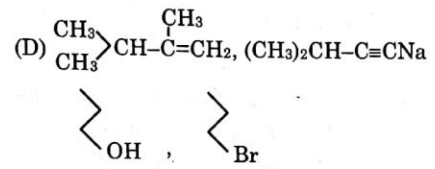
$$Q + S \longrightarrow \text{  } H$$

Which of the following set represents P, Q, R, S correctly and respectively.

(A) 

(B) 

(C) 

(D) 

Q.55 The lattice energy of NaCl (s) is 756 kJ/mole. The dissolution of the solid in water to form ions is endothermic to the extent of 4 kJ/mol. If the hydration energy of Na^+ and Cl^- are in the ratio 6 : 5, then the heat of hydration value of Na^+ ion is -

(A) – 410 kJ mol^{-1} (B) – 752 kJ mol^{-1}

(C) – 820 kJ mol^{-1} (D) – 341.81 kJ mol^{-1}

Q.56 A graph between $\log\frac{x}{m}$ and log P is a straight line at angle of 45° with the intercept on the y-axis equal to 0.3010. Under a pressure of 0.3 atmosphere, the amount of the gas adsorbed per gram of adsorbent is -

(A) 0.4 (B) 0.8 (C) 1.2 (D) 0.6

Q.57 1 mol of N_2 at 0.8 atm takes 38 seconds to diffuse through a pin Hole, whereas 1 mol of unknown compound of Xe with fluorine at 1.6 atm takes 57 seconds to diffuse through same hole. The molecular formula of the compound may be –

[F = 19] [Xe = 131]

(A) XeF_2 (B) XeF_6

(C) XeF_4 (D) None of these

Q.58 **Statement-I:** *Li* is the strongest reducing agent among alkali metals.

Statement-II: *Li* has the highest value of ionisation energy among alkali metals.

(A) Statement-I is true, statement-II is true & statement-II is not the correct explanation for statement-I

(B) Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I

(C) Statement-I is false, statement-II is true

(D) Statement-I is true, Statement-II is false

Q.59 Incorrect match is -

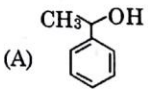
(A) Pyro silicate one oxygen shared

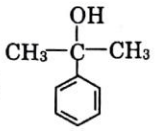
(B) silicones: $-(me)_2\,Si-O-$

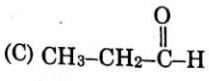
(C) Hypophosphoric acid : *P–P* bond

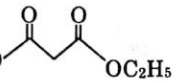
(D) Marshal acid : *S–S* bond

Q.60 $IO^{\ominus}$ gives positive test with

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.61 L-shaped proposed by & Kim & Kling for explaining the structure of -

(A) r-RNA (B) t-RNA

(C) m-RNA (D) Sn-RNA

Q.62 A rosette habit of cabbage, henbane can be converted in to vine habit by the application of -

(A) Cytokinin (B) NAA

(C) GA_3 (D) IBA

Q.63 In which of cell cycle syneptonemal complex becomes dissolved.
(A) Pachytene (B) Diakinesis
(C) Diplotene (D) Metaphase-I

Q.64 Deletion or insertion of one or two bases cause mutation in DNA that is called -
(A) Non-sence mutation
(B) Silent mutation
(C) Frame shift mutation
(D) Mis sence mutation

Q.65 The percentage of PAR that is used in photosynthesis by autotrophs -
(A) 1 – 5 % (B) 2 – 10 %
(C) 50 % (D) 20 %

Q.66 The function of leaf is performed by petiole in Australian acacia. This modification is called -
(A) Phylloclade (B) Cladode
(C) Phyllode (D) Staminode

Q.67 Bell shaped pyramid of human population indicates that the population is -
(A) Expanding (B) Stable
(C) Declining (D) None of these

Q.68 Which of the following help in absorption of phosphates for plants -
(A) Ectomycorrhiza (B) Lichen
(C) Glomus (D) Earthworm

Q.69 In lac operon, the inducer is -
(A) Galactose (B) Glucose
(C) Lactose (D) Permase

Q.70 The deficiency of which element affect the nitrogen fixation -
(A) Mo (B) Ca
(C) K^+ (D) Mn^{++}

Q.71 The length of the alimentary canal is more in herbivorous animals than the carnivorous because -
(A) Herbivorous diet contains more fat to digest
(B) Herbivorous diet contains more proteins to digest
(C) Herbivorous diet contains more carbohydrates particularly cellulose which takes more item to digest
(D) Herbivorous diet contains more vitamins to digest

Q.72 Lining of trachea is made of -
(A) Simple squamous epithelium
(B) Simple cuboidal epithelium
(C) Pseudo stratified epithelium
(D) Stratified cuboidal epithelium

Q.73 'Heart of Heart' is -
(A) SA node (B) AV node
(C) Bundle of His (D) Pukinje fibres

Q.74 Effect of thyroxine on B.M.R. is -
(A) increase (B) decrease
(C) uncertain (D) no effect

Q.75 In cataract -
(A) Due to ageing or some infection eye lens becomes opaque
(B) Elasticity of eye lens is lost
(C) There is irregular curvature of lens
(D) Eye ball becomes shorter

Q.76 Under normal conditions which one is completely in the renal tubule ?
(A) Urea (B) Uric acid
(C) Salts (D) Glucose

Q.77 The pelvic girdle, the acetabulum in man is formed by -
(A) Ileum, ischium and pubis
(B) Ileum, ischium and cotyloid
(C) Ileum and ischium
(D) Ileum and cotyloid

Q.78 Spermiogenesis changes -
(A) Spermatogonium to primary spermatocyte
(B) Primary spermatocyte to secondary spermatocyte
(C) Secondary spermatocyte to spermatid
(D) Spermatid to sperm

Q.79 What is correct formulation Hardy-Weinberg law ?
(A) $p^2 + 2pq + q^2 = 1$ (B) $p^2 + pq + q^2 = 1$
(C) $p^2 + 2pq + q^2 = 0$ (D) $p^2 + pq + q^2 = 0$

Q.80 dB is a standard abbreviation used for the quantitative expression of -
(A) A particular pollutant
(B) The dominant Bacillus in a culture
(C) A certain pesticide
(D) The density of bacteria in a medium

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 The area of the figure bounded by $y = \ell n\, x$ and $y = (\ell n\, x)^2$ is -
(A) $3 - e$ (B) $3 + e$
(C) $5 - e$ (D) $5 + e$

Q.82 Equation of a straight line meeting the circle $x^2 + y^2 = 100$ in two points, each point at a distance of 4 from the point (8, 6) on the circle, is -
(A) $4x + 3y - 50 = 0$ (B) $4x + 3y - 100 = 0$
(C) $4x + 3y - 46 = 0$ (D) none of these

Q.83 $\int \frac{x\,dx}{\sqrt{1+x^2+\sqrt{(1+x^2)^3}}}$ is equal to -
(A) $\frac{1}{2}\,\ell n\,(1+\sqrt{1+x^2}) + c$
(B) $2\sqrt{1+\sqrt{1+x^2}} + c$
(C) $2(1+\sqrt{1+x^2}) + c$
(D) none of these

Q.84 If in a rectangle $ABCD$ with $BC = 3AB$. Points P & Q are on BC such that $\angle DBC = \tan^{-1}(1/3)$; $\angle DPC = \tan^{-1}(1/2)$ & $\angle DBC = \angle DQC - \angle DPC$, then-
(A) point P and Q must trisect BC
(B) $PQ = 2AB$
(C) $\angle DOC = \pi/2$
(D) $AP = 2DQ$

Q.85 $|A_{3\times 3}| = 3$, $|B_{3\times 3}| = -1$ and $|C_{2\times 2}| = +2$ then $|2ABC| =$
(A) $2^3, 6$ (B) $2^3, (-6)$
(C) $2(-6)$ (D) none of these

Q.86 If $f(x) = x^x$; $[a, \infty] \to [b, \infty]$ is an invertible function then the minimum value of a and b are -
(A) $\frac{1}{e}, e^{-1/e}$ (B) $e, e^{1/e}$
(C) $\frac{1}{e}, e^{-e}$ (D) none of these

Q.87 Messages are conveyed by arranging 4 white, 1 blue and 3 red flags on a pole. Flags of the same colour are alike. If a message is transmitted by the order in which the colours are arranged then the total number of messages that can be transmitted if exactly 6 flags are used is -
(A) 45 (B) 65 (C) 125 (D) 185

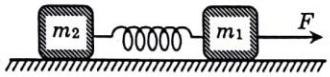
Q.88 The expression, $\frac{(a+b+c)(b+c-a)(c+a-b)(a+b-c)}{4b^2c^2}$ is equal to -
(A) $\cos^2 A$ (B) $\sin^2 A$
(C) $\cos A \cos B \cos C$ (D) none of these

Q.89 The angle at which the curve $y = 2e^{2x}$ intersects the y-axis is -
(A) $\tan^{-1} 4$ (B) $\cot^{-1} 4$
(C) $\tan^{-1} 2$ (D) $\cot^{-1} 2$

Q.90 Exact value of $\frac{\sin 22^\circ \cos 8^\circ + \cos 158^\circ \cos 98^\circ}{\sin 23^\circ \cos 7^\circ + \cos 157^\circ \cos 97^\circ}$ is -
(A) -1 (B) 1
(C) 0 (D) none of these

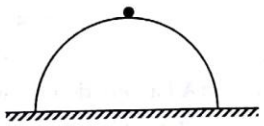
PHYSICS

Q.91 Two blocks of masses $m_1 = 1$ kg and $m_2 = 2$ kg are connected by a non-deformed light spring. They are lying on a rough horizontal surface. The coefficient of friction between the blocks and the surface is 0.4. What minimum constant force F has to be applied in horizontal direction to the block of mass m_1 in order to shift the other block ? ($g = 10$ m/s^2)



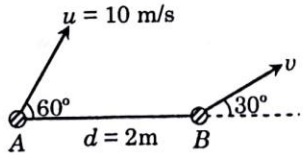
(A) 8 N (B) 15 N
(C) 10 N (D) 25 N

Q.92 A hemisphere of radius R and of mass 4 m is free to slide with its base on a smooth horizontal table. A particle of mass m is placed on the top of the hemisphere. The angular velocity of the particle relative to centre of hemisphere at an angular displacement θ when velocity of hemisphere has become v is -



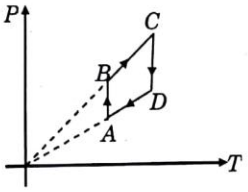
(A) $\frac{5v}{R\cos\theta}$ (B) $\frac{2v}{R\cos\theta}$
(C) $\frac{3v}{R\sin\theta}$ (D) $\frac{5v}{R\sin\theta}$

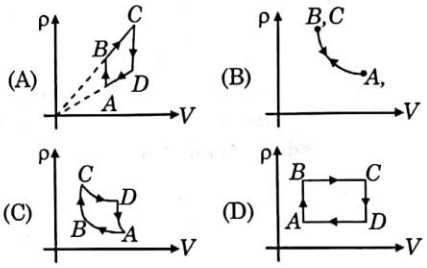
Q.93 Two particles A and B are situated at a distance d = 2m apart. Particle A has a velocity of 10 m/s at an angle of 60° and particle B has a velocity v at an angle 30° as shown in figure. The distance d between A and B the instant shown in figure is constant. The angular velocity of B with respect to A is -



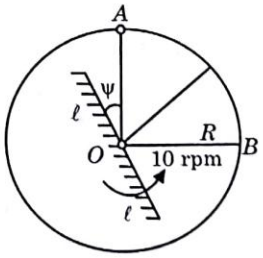
(A) $5\sqrt{3}$ rad/s (B) $\frac{5}{\sqrt{3}}$ rad/s
(C) $10\sqrt{3}$ rad/s (D) $\frac{10}{\sqrt{3}}$ rad/s

Q.94 Pressure versus temperature graph of an ideal gas is as shown in figure corresponding density (ρ) versus volume (V) graph will be -



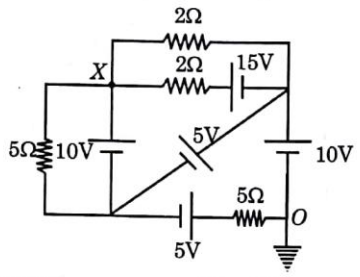


Q.95 The mirror of length 2ℓ makes 10 revolutions per minute about the axis crossing its mid point O and perpendicular to the plane of the figure There is a light source in point A and an observer at point B of the circle of radius R drawn around centre O ($\angle AOB = 90°$) What is the proportion $\frac{R}{\ell}$ if the observer B sees the light source first time when the angle of mirror $\psi = 15°$?



(A) $\sqrt{2}$ (B) $\frac{1}{\sqrt{2}}$ (C) $2\sqrt{2}$ (D) $\frac{1}{2\sqrt{2}}$

Q.96 In the circuit shown if point O is earthed, the potential of point X is equal to -



(A) 10 V (B) 15 V
(C) 25 V (D) 12.5 V

Q.97 The mass per unit length of a non-uniform rod OP of length L varies as $m = k\frac{x}{L}$ where k is a constant and x is the distance of any point on the rod from end O. The distance of the centre of mass of the rod from end O is -

(A) $\frac{L}{3}$ (B) $\frac{2L}{3}$ (C) $\frac{L}{2}$ (D) $\frac{2L}{\sqrt{3}}$

Q.98 A point charge q is placed inside a conducting spherical shell of inner radius $2R$ and outer radius $3R$ at a distance of R from centre of the shell. The electric potential at the centre of shell will be.

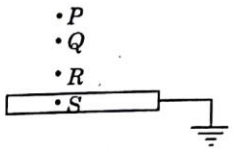
(A) $\frac{q}{4\pi\epsilon_0 2R}$

(B) $\frac{4q}{12\pi\epsilon_0 R}$

(C) $\frac{5q}{24\pi\epsilon_0 R}$

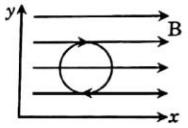
(D) Can't be determined

Q.99 A positive point charge is placed at P in front of an earthed metal sheet S. Q and R are two points between P and S as shown in figure. If the electric field strength at Q and R are respectively E_Q and E_R and potential at Q and R are respectively V_Q and V_R, then -



(A) $E_Q > E_R$ (B) $E_Q < E_R$
(C) $V_Q = V_R$ (D) $V_Q < V_R$

Q.100 A circular current loop is shown in the adjacent figure. The magnetic field in the region is along x-axis and its magnitude in the space is increasing with increasing y-coordinate. The net magnetic force on the loop is -



(A) along + z-axis (B) along – z-axis
(C) along +y-axis (D) None of these

CHEMISTRY

Q.101 S_1 : All adiabatic processes are isoentropic processes.

S_2 : When $(\Delta G_{system})_{T,P} < 0$; the reaction must be exothermic.

S_3 : Radial nodes can appear when radial probability distribution function become zero.

(A) TTF (B) FFT
(C) TFT (D) TF

Q.102 Zn Amalgam is prepared by electrolysis of aqueous $ZnCl_2$ using Hg cathode (9gm). How much current is to be passed through $ZnCl_2$ solution for 1000 seconds to prepare a Zn Amalgam with 25 % Zn by wt. (Zn = 65.4)

(A) 5.6 amp (B) 7.2 amp
(C) 8.85 amp (D) 11.2 amp

Q.103 A solution of $Na_2S_2O_3$ is standardized iodimetrically against 0.1262 g of $KBrO_3$. This process requires 456 mL of the $Na_2S_2O_3$ solution. What is the molarity of the $Na_2S_2O_3$?

(A) 0.2 M (B) 0.5 M

(C) 0.05 M (D) 0.1 M

Q.104 Analysis show that nickel oxide consist of nickel ion with 96% ions having d^8 configuration and 4% having d^7 configuration. Which amongst the following best represent the formula of the oxide.

(A) $Ni_{1.02}O_{1.00}$ (B) $Ni_{0.96}O_{1.00}$

(C) $Ni_{0.98}O_{0.98}$ (D) $Ni_{0.98}O_{1.00}$

Q.105 Select the **INCORRECT** statement -

(A) N_2O with sodium metal in liquid ammonia forms sodium azide and nitrogen gas is liberated.

(B) Ammonia is oxidized to nitrogen by dilute solution of sodium hypochlorite in presence of glue.

(C) Ammonium dichromate on heating decomposes to give nitrogen and a green coloured compound.

(D) CaNCN on hydrolysis produces a white precipitate and a gas which turns filter paper moistened with copper sulphate solution deep blue.

Q.106 An energy of 40.8 eV is required to excite a Hydrogen-like species from 1st Bohr orbit to second. Which is/are correct statement(s) -

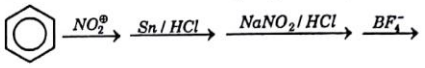
(A) Atomic number of H-like species is 2.

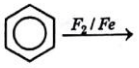
(B) Ionization energy of H-like species is 122.4 eV.

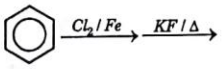
(C) Kinetic energy of electron in 1st orbit is 50.4 eV

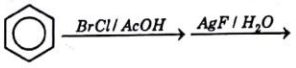
(D) Energy of third orbit is –13.6 eV

Q.107 Fluorobenzene is best prepared by

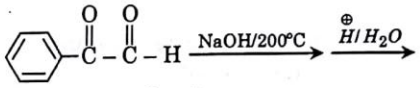
(A) 

(B) 

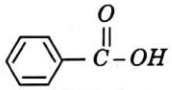
(C) 

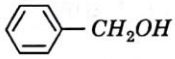
(D) 

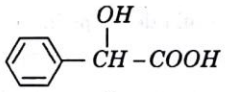
Q.108 In the reaction,

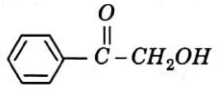


the major product is –

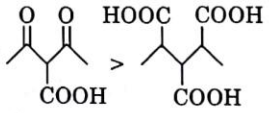
(A) 

(B) 

(C) 

(D) 

Q.109 The correct orders are -

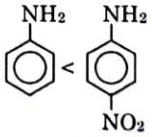
(A) 
(rate of decarboxylation)

(B) $CH_3–CH=O < CH_3–\underset{\underset{O}{\|}}{C}–CH_3$

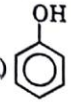
(rate of aldol condensation)

(C) $CH_3–\underset{\underset{O}{\|}}{C}–OEt > CH_3–\underset{\underset{O}{\|}}{C}–CH_3$

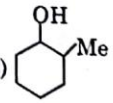
(rate of base catalysed condensation)

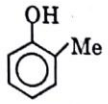
(D) 
(rate of diazocoupling with $Ph\overset{\oplus}{N}_2$)

Q.110 The rate of estrification of CH_3COOH is fastest with -

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.111 In dark cycle, one molecule of glucose formation needed -

(A) 12 ATP and 12 NADPH

(B) 14 ATP and 12 NADPH

(3) 16 ATP and 12 NADPH

(D) 18 ATP and 12 NADPH

Q.112 Microsporangia develops in to -

(A) Pollens (B) Microgametes

(C) Magagametes (D) Pollen sacs

Q.113 The phenotypic ratio of a monohybrid cross in F_2-generatin is -

(A) 3 : 1 (B) 1 : 2 : 1

(C) 2 : 1 : 1 (D) 9 : 3 : 3 : 1

Q.114. The recessive genes located on X-chromosome in humans are always -

(A) Lethal

(B) Sub-lethal

(C) Expressed in males

(D) Expressed in females

Q.115 Frameshift mutation and base pair substitution changes the -

(A) Nucleotide structure

(B) Nucleotide sequence

(C) Nucleoside sequence

(D) Sugar phosphate sequence

Q.116 Turner's syndrome caused due to the absence of -

(A) One X-chromosome (44 with XO)

(B) One Y-chromosome

(C) One X and Y-chromosome

(D) Two X-chromosomes

Q.117 Nucleoside is formed when the nitrogenous bases are linked to -

(A) Sugar (B) Phosphate

(C) Proteins (D) Fats

Q.118 In bacteria, the transcription and translation takes place in the same compartment because there is -

(A) Separation of cytosol and nucleus

(B) Separation of cytoplasmic organelies

(C) Separation of cytosol and nucleus

(D) Presence of nucleus

Q.119 In *E. coli*, hydrolysis of disaccharide, lactose into galactose and glucose is performed by -

(A) Permease (B) Catalase

(C) β-galactosidase (D) Transacylase

Q.120 Polymerase chain reaction employs -

(A) Primers and DNA ligase

(B) DNA ligase only

(C) DNA polymerase

(D) Primer and DNA polymerase

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-7

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 $\lim\limits_{n\to\infty}\left[\sum\limits_{r=1}^{n}\frac{1}{2^r}\right]$, where $[\cdot]$ denotes the greatest integer function, is equal to -

(A) 1 (B) 0

(C) Non-existent (D) None of these

Q.2 If $f(x) = 0$ be a quadratic equation such that $f(-\pi) = f(\pi) = 0$ and $f\left(\frac{\pi}{2}\right) = -\frac{3\pi^2}{4}$, then $\lim\limits_{x\to-\pi}\frac{f(x)}{\sin(\sin x)}$ is equal to -

(A) 0 (B) π

(C) 2π (D) None of these

Q.3 If $f(x) = x \mid x \mid - \ell n\, x^2$, then which statement is not true ?

(A) $f(x)$ is increasing in $(-\infty, 0)$

(B) $f(x)$ is decreasing in $(0, \infty)$

(C) $f(x)$ is increasing in $(1, \infty)$

(D) $f(x)$ is decreasing in $(0, 1)$

Q.4 Maximum value of the expression $\frac{10x^{12}}{x^{24}+2x^{12}+3x^{16}+3x^{8}+1}$ is equal to-

(A) 1

(B) 2

(C) 10

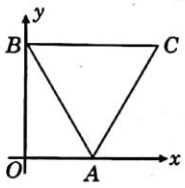
(D) not defined

Q.5 Solution (x, y) of the system of equation $x - y = \frac{1}{3}$ and $\cos^2(\pi x) - \sin^2(\pi y) = \frac{1}{2}$ is given by and $n \in I$ -

(A) $\left(\frac{2}{3}, \frac{1}{3}\right)$ (B) $\left(\frac{7}{6}, \frac{1}{6}\right)$

(C) $\left(\frac{13}{6}, \frac{11}{6}\right)$ (D) $\left(\frac{1}{6}, \frac{5}{6}\right)$

Q.6 Adjacent figure represents a equilateral triangle ABC of side length 2 units. Locus of vertex 'C' as the side AB slides along the coordinate axes is -



(A) $x^2 + y^2 - xy + 1 = 0$

(B) $x^2 + y^2 + xy\sqrt{3} = 1$

(C) $x^2 + y^2 = 1 + xy\sqrt{3}$

(D) $x^2 + y^2 - xy\sqrt{3} + 1 = 0$

Q.7 Let $f(x) = a^x$ $(a > 0)$ be written as $f(x) = g(x) + h(x)$, where $g(x)$ is an even function and $h(x)$ is an odd function. Then the value of the $g(x+y) + g(x-y)$ is -

(A) $2g(x) \cdot g(y)$

(B) $2g(x+y) \cdot g(x-y)$

(C) $2\,g(x)$

(D) none of these

Q.8 $f(x) = (-1)^{\left[\frac{2x}{\pi}\right]}$, $g(x) = |\sin x| - |\cos x|$, $\phi(x) = f(x)\,g(x)$, where [ ] denotes G.I.F. then fundamental period of $f(x)$, $g(x)$, $\phi(x)$ are -

(A) π, π, π (B) $\pi, 2\pi, \pi$

(C) $\pi, \pi, \frac{\pi}{2}$ (D) $\pi, \frac{\pi}{2}, \pi$

Q.9 Two circles of radii 4 cm and 1 cm touch each other externally and θ is the angle contained by their direct common tangents. Then $\sin\theta$ is equal to -

(A) $\frac{24}{25}$ (B) $\frac{12}{25}$

(C) $\frac{3}{4}$ (D) None of these

Q.10 If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a} \times \vec{b}| = 2$ then value of $\left[\vec{a}\ \vec{b}\ \vec{a} \times \vec{b}\right]$ is equal to -

(A) 1 (B) 2 (C) 4 (D) 0

Q.11 The mean of, 0 1, 2, 3, ...n, with the corresponding weight ${}^nC_0, {}^nC_1, {}^nC_2, \ldots {}^nC_n$ is -

(A) $\frac{2^n}{n+1}$ (B) $\frac{2^{n+1}}{n(n+1)}$

(C) $\frac{n+1}{2}$ (D) $\frac{n}{2}$

Q.12 If a, b, c are in G.P., x and y be the arithmetic mean between a, b and b, c respectively, the $\left(\frac{a}{x} + \frac{c}{y}\right)\left(\frac{b}{x} + \frac{b}{y}\right)$ is equal to –

(A) 2 (B) – 4 (C) 4 (D) 6

Q.13 Equation $\sqrt{ax} + \sqrt{by} = 1$ represents -

(A) circle (B) a parabola

(C) an ellipse (D) hyperbola

Q.14 If $A = [a_{ij}]_{4\times4}$ such that

$a_{ij} = \begin{cases} 2, & \text{when } i = j \\ 0, & \text{when } i \neq j \end{cases}$, the $\left\{\frac{\det(adj(adj\,A))}{7}\right\}$ is (where {.} represents fractional part function).

(A) 1/7 (B) 2/7

(C) 3/7 (D) None of these

Q.15 If $f : R \to R$ and for a fixed positive number c ; $f(x + c) = 1 + [1 - 5f(x) + 10\{f(x)\}^2 - 10\{f(x)\}^3 + 5\{f(x)\}^4 - \{f(x)\}5]1/5 \ \forall \ x \in R$, then $f(x)$ is a periodic function whose period can be -

(A) c (B) $2c$ (C) $3c$ (D) $5c$

Q.16 If positive numbers a^{-1}, b^{-1}, c^{-1} $(a \neq b \neq c)$ are in A.P., then product of roots of equation $x^2 - kx + 2b^{101} - a^{101} - c^{101} = 0 (k \in R)$ -

(A) has +ve sign (B) has –ve sign

(C) equal to zero (D) not definite

Q.17 If $P(x)$ is a polynomial of the least degree that has a maximum equal to 6 at $x = 1$, and a minimum equal to 2 at $x = 3$, then $\int_0^1 P(x)\,dx$ equals -

(A) $\frac{17}{4}$ (B) $\frac{13}{4}$ (C) $\frac{19}{4}$ (D) $\frac{5}{4}$

Q.18 If the conics whose equations are $S \equiv \sin^2\theta\, x^2 + 2hxy + \cos^2\theta\, y^2 + 32x + 16y + 19 = 0$, $S' \equiv \cos^2\theta\, x^2 + 2h'xy + \sin^2\theta\, y^2 + 16x + 32y + 19 = 0$ intersects in four concyclic points then, (where $\theta \in R$) -

(A) $h + h' = 0$ (B) $h = h'$

(C) $h + h' = 1$ (D) None of these

Q.19 A tangent is drawn to the parabola $y^2 = 4x$ at the point 'P' whose abscissa lies in the interval [1, 4]. The maximum possible area of the triangle formed by the tangent at 'P' ordinates of the point 'P' and the x-axis is equal to -

(A) 8 (B) 16 (C) 24 (D) 32

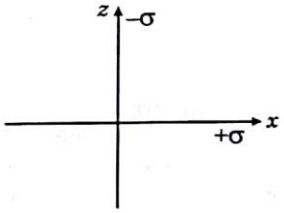
Q.20 $f : R \to R$ such that $f(x + 2y) = f(x) + f(2y) + 4xy$, $\forall \ x, y \in R$. If $I_1 = \int_0^1 f(x)dx$, $I_2 = \int_{-1}^0 f(x)dx$, $I_3 = \int_{1/2}^2 f(x)dx$, then-

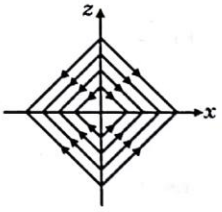
(A) $I_1 = I_2 > I_3$ (B) $I_1 > I_2 > I_3$

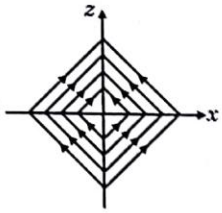
(C) $I_1 = I_2 < I_3$ (D) $I_1 < I_2 < I_3$

PHYSICS

Q.21 Two infinitely large charged planes having uniform surface charge density $+\sigma$ and $-\sigma$ are placed along x-y plane and yz plane respectively as shown in the figure. Then the nature of electric lines of forces in x-z plane is given by :



(A)


(B)


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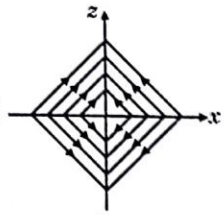
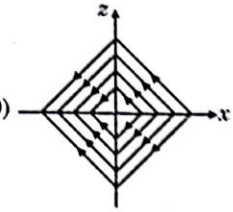
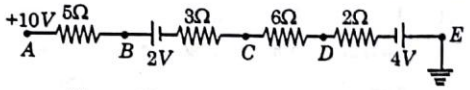


(D)


Q.22 In the circuit shown in the figure, the potential difference between B and C is :

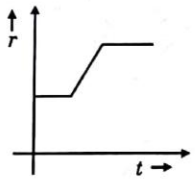


(A) 0.1 V (B) 2 V
(C) 0.5 V (D) 4.25 V

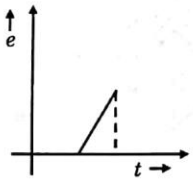
Q.23 An α particle is moving along a circle of radius R with a constant angular velocity ω. Point A lies in the same plane at a distance $2R$ from the centre. Point A records magnetic field produced by α particle. If the minimum time interval between two successive times at which A records zero magnetic field is 't', the angular speed ω, in terms of t is :

(A) $\frac{2\pi}{t}$ (B) $\frac{2\pi}{3t}$ (C) $\frac{\pi}{3t}$ (D) $\frac{\pi}{t}$

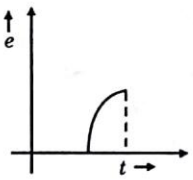
Q.24 Radius of a circular ring is changing with time and the coil is placed in uniform constant magnetic field perpendicular to its plane. The variation of 'r' with time 't' is shown in the figure. Then induced e.m.f.ε with time will be best represented by :



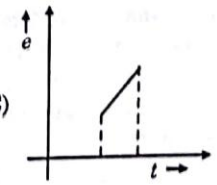
(A)



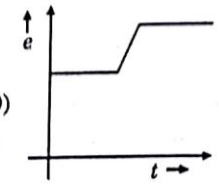
(B)



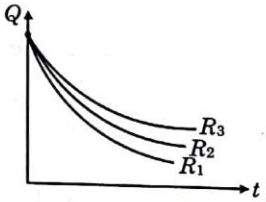
(C)



(D)

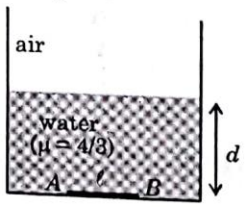


Q.25 Three identical capacitors are given a charge Q each and they are then allowed to discharge through resistance R_1, R_2 and R_3 separately. Their charges, as a function of time are shown in the graph below. The smallest of the three resistances is :



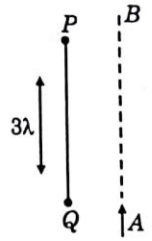
(A) R_3
(B) R_2
(C) R_1
(D) Cannot be predicted

Q.26 AB is small object dipped in water at a depth of d. Its length is ℓ. It is seen from air at near normal incidence. The length of the image is :



(A) ℓ (B) $\mu\ell$
(C) ℓ/μ (D) None of these

Q.27 Two coherent light sources P and Q each of wavelength λ are separated by a distance 3λ as shown. The maximum number of minima formed on line AB which runs from $-\infty$ to $+\infty$ is :



(A) 2 (B) 4 (C) 6 (D) 8

Q.28 For a LCR series circuit with an A.C. source of angular frequency ω.

(A) circuit will be capacitive if $\omega > \frac{1}{\sqrt{LC}}$

(B) circuit will be inductive if $\omega = \frac{1}{\sqrt{LC}}$

(C) power factor of circuit will be unity if capacitive reactance equals inductive reactance

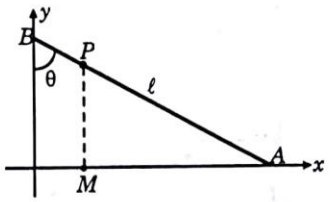
(D) current will be leading voltage if $\omega > \frac{1}{\sqrt{LC}}$

Q.29 A heavy nucleus having mass number 200 gets disintegrated into two small fragments of mass number 80 and 120. If binding energy per nucleon for parent atom is 6.5 MeV and for daughter nuclei is 7 MeV and 8 MeV respectively, then the energy released in the decay will be :

(A) 200 MeV (B) –220 MeV

(C) 220 MeV (D)180 MeV

Q.30 A rod of length ℓ is in motion such that its ends A and B are moving along x-axis and y-axis respectively. It is given that $\frac{d\theta}{dt} = 2$ rad/s always. P is a fixed point on the rod. Let M be the projection of P on x-axis. For the time interval in which θ changes from 0 to $\frac{\pi}{2}$, choose the correct statement :



(A) the acceleration of M is always directed towards right

(B) M executes SHM

(C) M moves with constant speed

(D) M moves with constant acceleration

Q.31 The molar heat capacity of a polytropic process (PV^n) is $C = C_V + \frac{R}{10}$. The value of the polytropic exponent n is :

(A) 11 (B) 10

(C) –10 (D) –9

Q.32 When a wave is refracted by rarer medium :

(A) phase must change

(B) amplitude must change

(C) frequency must change

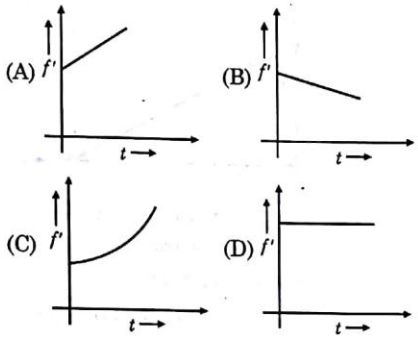
(D) None of these

Q.33 A small mass slides down an inclined plane of inclination θ with the horizontal. The co-efficient of friction is $\mu = \mu_0 x$ where x is the distance through which the mass slides down and μ_0 a constant. Then the speed is maximum after the mass covers a distance of :

(A) $\frac{\cos\theta}{\mu_0}$ (B) $\frac{\sin\theta}{\mu_0}$

(C) $\frac{\tan\theta}{\mu_0}$ (D) $\frac{2\tan\theta}{\mu_0}$

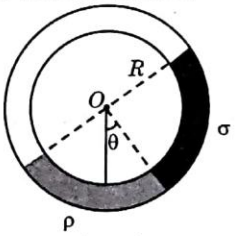
Q.34 A source of frequency 'f' is stationary and an observer starts moving towards it at $t = 0$ with constant small acceleration. Then the variation of observed frequency f′ registered by the observer with time is best represented as :



Q.35 A tunnel is dug in the earth across one of its diameter. Two masses 'm' & '$2m$' are dropped from the ends of the tunnel. The masses collide and stick to each other and perform S.H.M. Then amplitude of S.H.M. will be [R = radius of the earth]

(A) R (B) R/2 (C) R/3 (D) 2R/3

Q.36 A small uniform tube is bent into a circular tube of radius R and kept in the vertical plane. Equal volumes of two liquids of densities ρ and σ (ρ > σ) fill half of the tube as shown. θ is the angle which the radius passing through the interface makes with the vertical :



(A) $\theta = \tan^{-1}\left(\frac{\rho-\sigma}{\rho+\sigma}\right)$ (B) $\theta = \tan^{-1}\left(\frac{\sigma-\rho}{\sigma+\rho}\right)$

(C) $\theta = \tan^{-1}\left(\frac{\rho}{\rho+\sigma}\right)$ (D) $\theta = \tan^{-1}\left(\frac{\rho}{\rho-\sigma}\right)$

Q.37 All electrons ejected from a surface by incident light of wavelength 200 nm can be stopped before travelling ı m in the direction of uniform electric field of 4 N/C. The work function of the surface is :

(A) 4 eV (B) 6.2 eV

(C) 2 eV (D) 2.2 eV

Q.38 A point mass 'm' and charge 'q' is projected with a velocity v towards a stationary charge Q_0 from a distance of 2 m. The closest distance that q can approach is : $[k = \frac{1}{4\pi\varepsilon_0}]$

(A) $\frac{mv^2 + kqQ_0}{kQ_0q}$ (B) $\frac{KQ_0}{mv^2 + KqQ_0}$

(C) $\frac{kQ_0 + mv^2}{kqQ_0}$ (D) $\frac{kQ_0 - mv^2}{kqQ_0}$

Q.39 The magnetic flux ϕ through a metal ring varies with time t according to :

$\phi = 3(at^3 - bt^2)$ Tm², with $a = 2s^{-3}$ and $b = 6\ s^{-2}$

The resistance of the ring is 3 Ω. The maximum current induced in the ring during the interval $t = 0$ to $t = 2$s, is :

(A) 1A (B) 2A

(C) 3A (D) 6A

Q40 A coin is released inside a lift at a height of 2 m from the floor of the lift. The height of the lift is 10 m. The lift is moving with an acceleration of 9 m/s² downwards. The time after which the coin will strike with the lift is : (g = 10 m/s²) :

(A) 4 s (B) 2 s

(C) $\frac{4}{\sqrt{21}}$ s (D) $\frac{2}{\sqrt{11}}$ s

CHEMISTRY

Q.41 2 mole, equimolar mixture of $Na_2C_2O_4$ and $H_2C_2O_4$ required V_1L of 0.1 M $KMnO_4$ in acidic medium for complete oxidation. The same amount of the mixture required V_2L of 0.2 M $NaOH$ for neutralization. The ratio of V_1 to V_2 is -

(A) 1 : 2 (B) 2 : 1
(C) 4 : 5 (D) 5 : 4

Q.42 If a_0 be the radius of first Bohr's orbit of H-atom, the de-Broglie's wavelength of an electron revolving in the second Bohr's orbit will be -

(A) $6\pi a_0$ (B) $4\pi a_0$
(C) $2\pi a_0$ (D) None of these

Q.43 The root mean square speed of 8 g of He is 300 ms^{-1}. Total kinetic energy of He gas is -

(A) 120 J (B) 240 J
(C) 360 J (D) None of these

Q.44 10 mole of ideal gas expand isothermally and reversibly from a pressure of 10 atm to 1 atm at 300 K. What is the largest mass which can lifted through a height of 100 meter ?

(A) 31842 kg (B) 58.55 kg
(C) 342.58 kg (D) None of these

Q.45 $COCl_2$ gas dissociates according to the equation, $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$. When heated to 700 K the density of the gas mixture at 1.16 atm and at equilibrium is 1.16 g/litre. The degree of dissociation of CO_2 at 700 K is -

(A) 0.28 (B) 0.50 (C) 0.72 (D) 0.42

Q.46 Rate constant k = 2.303 min^{-1} for a particular reaction. The initial concentration of the reaction is 1 mol/litre then rate of reaction after 1 minute is

(A) 2.303 M min^{-1} (B) 0.2303 M min^{-1}
(C) 0.1 M min^{-1} (D) None of these

Q.47 What is the pH of a saturated solution of $Cu(OH)_2$? ($K_{sp} = 2.6 \times 10^{-19}$)

(A) 6.1 (B) 7.30
(C) 8.42 (D) 7.90

Q.48 An electrolysis of a oxytungsten complex ion using 1.10 A for 40 min produces 0.838 g of tungsten. What is the charge of tungsten in the materials?

(Atomic wt., W = 184)

(A) 6 (B) 2 (C) 4 (D) 1

Q.49 6.0 g of urea (molecular weight = 60) was dissolved in 9.9 moles of water. If the vapour pressure of pure water is P^o, the vapour pressure of solution is -

(A) 0.10 P^o (B) 1.10 P^o
(C) 0.90 P^o (D) 0.99 P^o

Q.50 An element X (At. wt = 80 g/mol) having fcc structure, calculate no. of unit cells in 8 gm of X :

(A) $0.4 \times N_A$ (B) $0.1 \times N_A$
(C) $4 \times N_A$ (D) None of these

Q.51 In Brownian motion, the paths of the particles are -

(A) linear (B) curved
(C) zig-zag (D) uncertain

Q.52 Consider the following changes :

$M(s) \rightarrow M(g)$ .....(1)
$M(s) \rightarrow M^{2+}(g) + 2e^-$ .....(2)
$M(g) \rightarrow M^{+}(g) + e^-$ .....(3)
$M^{+}(g) \rightarrow M^{2+}(g) + e^-$ .....(4)
$M(g) \rightarrow M^{2+}(g) + 2e^-$ .....(5)

The second ionization energy of M could be calculated from the energy values associated with

(A) 1 + 3 + 4 (B) 2 – 1 + 3
(C) 1 + 5 (D) 5 – 3

Q.53 The correct order of strength of *H*-bond in the following compound -

(A) $H_2O > H_2O_2 > HF > H_2S$

(B) $HF > H_2O_2 > H_2O > H_2S$

(C) $HF > H_2O > H_2S > H_2O_2$

(D) $HF > H_2O > H_2O_2 > H_2S$

Q.54 Select correct statement -

(A) Acidic strength of $HBr > HCl$ but reverse is true for their reducing property

(B) Basic strength of $PH_3 > AsH_3$ but reverse is true for their Bond angle

(C) Dipole moment of $CH_3Cl > CH_3F$ but reverse is true for their HCH bond angle

(D) K_{a_1} of fumaric acid is higher than maleic acid but reverse is true for their K_{a_2}

Q.55 Select pair of compounds in which both have different hybridization but have same molecular geometry -

(A) BF_3, BrF_3 (B) $ICl_2^{\ominus}$, $BeCl_2$

(C) BCl_3, PCl_3 (D) PCl_3, NCl_3

Q.56 In the isoelectronic series of metal carbonyl, the CO bond strength is expected to increase in the order -

(A) $[Mn(CO)_6]^+ < [Cr(CO)_6] < [V(CO)_6]^-$

(B) $[V(CO)_6]^- < [Cr(CO)_6] < [Mn(CO)_6]^+$

(C) $[V(CO)_6]^- < [Mn(CO)_6]^+ < [Cr(CO)_6]$

(D) $[Cr(CO)_6] < [Mn(CO)_6]^+ < [V(CO)_6]^-$

Q.57 $AgCl$ on fusion with Na_2CO_3 forms -

(A) Ag_2CO_3 (B) Ag_2O

(C) Ag (D) Ag_2C_2

Q.58 A colourless water soluble solid '*X*' on heating gives equimolar quantities of *Y* and *Z*, *Y* gives dense white fumes HCl and *Z* does so with NH_3. *Y* gives brown precipitate with Nessler's reagent and *Z* gives white precipitate with nitrates of Ag^+, Pb^{2+} and Hg^+ '*X*' is-

(A) NH_4Cl (B) NH_4NO_3

(C) NH_4NO_2 (D) $FeSO_4$

Q.59 Calcium imide on hydrolysis gives gas (*B*) which on oxidation by bleaching powder gives gas (*C*). Gas (*C*) on reaction with magnesium give compound (*D*) which on hydrolysis gives again gas (*B*). Identify (*B*), (*C*) and (*D*)

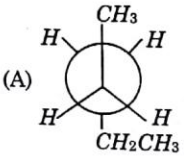
(A) NH_3, N_2, Mg_3N_2

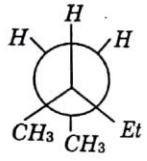
(B) N_2, NH_3, $MgNH$

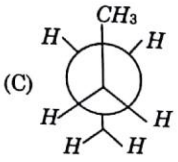
(C) N_2, N_2O_5, $Mg(NO_3)_2$

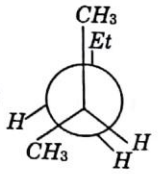
(D) NH_3, NO_2, $Mg(NO_2)_2$

Q.60 Identify conformer of 2-methyl pentane-

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.61 Plants that have nectoriess, scentless flowers containing pollen grains coated by mucilage, are pollinated by :

(A) Bird (B) Wind

(C) Water (D) Insects

Q.62 Restriction endonucleases are enzymes that cleave DNA molecules into smaller fragments. Which type of bond do they act on ?

(A) N-glycosidic Bond

(B) Phosphodiester bond

(C) Hydrogen bond

(D) Disulfide bond

Q.63 The first stable product of fixation of atmospheric nitrogen in leguminous plants is :

(A) Ammonia (B) NO_3^-

(C) Glutamate3 (D) NO_2^-

Q.64 Besides paddy fields, cyanobacteria are also found inside vegetative part of :

(A) Cycas (B) Equisetum

(C) Psilotum (D) Pinus

Q.65 Which of the metabolites is common to respiraton mediated breadkdown of fats, carbohydrates and proteins ?

(A) Frutose 1, 6-bisphosphate

(B) Pyruvic acid

(C) Acetyl CoA

(D) Glucose-6-phosphate

Q.66 Gobar gas is produced by the activity of

(A) Pseudomonas (B) Bacillus

(C) Methanogens (D) Cyanobacteria

Q.67 Mitochondria are associated with all of the following functions, EXCEPT :

(A) ATP synthesis

(B) DNA syntheis

(C) Protein synthesis

(D) Protein glycosylation

Q.68 Meiosis takes place in :

(A) Conidia (B) Gemmule

(C) Megaspore (D) Meiocyte

Q.69 The complex formed by a pair of synapsed homologous chromosomes is called :

(A) Kinetochore (B) Bivalent

(C) Axoneme (D) Equatorial plate

Q.70 The Golgi complex plays a major role :

(A) in digesting proteins and carbohydrates

(B) as energy transferring organelles

(C) in post translational modification of proteins and glycosidation of lipids

(D) in trapping the light and transforming it into chemical energy

Q.71 Match column I with column II

	Column I		Column II
(A)	Smack	(P)	Erythroxylon Coca
(B)	Morphine	(Q)	Sedative & Painkiller
(C)	Cannabinoids	(R)	Diacetylmorphine
(D)	Crack	(S)	Marijuana

(A) A → P, B → S, C → Q, D → R

(B) A → R, B → Q, C → S, D → P

(C) A → R, B → S, C → P, D → D

(D) A → R, B → Q, C → P, D → Q

Q.72 Find out wrong pair :

(A) Spermatozoa - Sperm

(B) Interstitial cell - Leydig cells

(C) Follicular phase - Secretory phase

(D) Spermatogonia - Male germs cell

Q.73 Match column I with column II

(A) IUDS - (i) Absence of menstruation

(B) condoms - (ii) Lippes loop, Cu-T, multiload 375

(C) Lactational - (iii) Made of thin rubber/latex Amenorrhea

(D) Saheli - (iv) oral contraceptive

(A) A-i, B-iii, C-ii, D-iv

(B) A-iii, B-i, C-ii, D-iv

(C) A-ii, B-iii, C-i, D-iv

(D) A-i, B-ii, C-iii, D-iv

Q.74 Globulins contained in human blood plasma are primarily involved in :

(A) Defence mechanisms of body

(B) osmotic balance of body fluid

(C) oxygen transport in the blood

(D) clotting of blood

Q.75 Acquired immunity is due to :

(A) physiological & inflammatory barrier

(B) Lymphocyte

(C) Erythrocytes

(D) NK-cells

Q.76 Match column I with column II

Column I	Column II
(A) Kwashiorkor	(i) Iron
(B) General Anaemia	(ii) Biotin
(C) Dermatitis	(iii) Protein
(D) Pellegra	(iv) Niacin

(A) A (iv), B (i), C (ii), D (iii)

(B) A (ii), B (i), C (iii), D (iv)

(C) A (iii), B (i), C (ii), D (iv)

(D) A (i), B (iii), C (ii), D (iv)

Q.77 In ELISA TEST substance used is :

(A) Peroxidase (B) Polymerase

(C) Ligase (D) Endonuclease

Q.78 Match the scientists listed under column 'A' with ideas listed column 'B'.

Column A	Column B
i. Darwin	M. abiogenesis
ii. Oparin	N. use and disuse of organs
iii. Lamarck	O. continental drift theory
iv. Wagner	P. evolution by natural selection

(A) i-M; ii-P; iii-N; iv-O

(B) i-P; ii-M; iii-N; iv-O

(C) i-N; ii-P; iii-O, iv-M

(D) i-P; ii-O, iii-N; iv-M

Q.79 Vivipartiy is considered to be more evolved because :

(A) the young ones are left on their own

(B) the young ones are protected by a thick shell

(C) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

(D) the embryo takes a long time to develop

Q.80 The cranial capacity of Java ape man was about :

(A) 560 c.c. (B) 900 c.c.

(C) 1,300 c.c. (D) 1,000 c.c.

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 If $x = {}^{n}C_{n-1} + {}^{n+1}C_{n-1} + ..+ {}^{2n-1}C_{n-1}$ then $\frac{x+1}{n+1}$ is :

(A) an integer iff n is odd integer

(B) an integer iff n is an even integer

(C) never integer

(D) always integer

Q.82 If (x_1, y_1) & (x_2, y_2) are the ends of a diameter of a circle such that x_1 & x_2 are the roots of the equation $ax^2 + bx + c = 0$ and y_1 & y_2 are the roots of the equation ; $py^2 + qy + c = 0$. Then the co-ordinates of the centre of the circle is :

(A) $\left(\frac{b}{2a}, \frac{q}{2p}\right)$ (B) $\left(-\frac{b}{2a}, -\frac{q}{2p}\right)$

(C) $\left(\frac{b}{a}, \frac{q}{p}\right)$ (D) None of these

Q.83 If α, β be the roots of the equation $u^2 - 2u + 2 = 0$ & if $\cot\theta = x + 1$, then $\frac{(x+\alpha)^n - (x+\beta)^n}{\alpha - \beta}$ is equal to :

(A) $\frac{\sin n\theta}{\sin^n\theta}$ (B) $\frac{\cos n\theta}{\cos^n\theta}$

(C) $\frac{\sin n\theta}{\cos^n\theta}$ (D) $\frac{\cos n\theta}{\sin^n\theta}$

Q.84 If $y = \sin^{-1}(x\sqrt{1-x} + \sqrt{x}\sqrt{1-x^2})$ & $\frac{dy}{dx} = \frac{1}{2\sqrt{x(1-x)}} + p$, then $p =$

(A) 0 (B) $\sin^{-1} x$

(C) $\sin^{-1}\sqrt{x}$ (D) None of these

Q.85 A chord of the parabola $y = -a^2x^2 + 5ax - 4$ touches the curve $y = \frac{1}{1-x}$ at the point $x = 2$ and is bisected by that point. If S is the sum of all possible values of a, then find 12 S :

(A) 12 (B) 15 (C) 17 (D) 19

Q.86 The total number of combinations 6 at a time which can be formed from 6 alike white, 6 alike blue, 6 alike green & 6 alike red balls is :

(A) 90 (B) 84

(C) 78 (D) None of these

Q.87 If $c^2 = a^2 + b^2$, $2s = a + b + c$, then $4s(s-a)(s-b)(s-c) =$

(A) s^4 (B) b^2c^2 (C) c^2a^2 (D) a^2b^2

Q.88 Solution of the differential equation $\frac{dy}{dx} - y = \cos x - \sin x$ satisfying the condition that y should be bounded when $x \to +\infty$ is :

(A) $y = \sin x$ (B) $y = \cos x$

(C) $y = \sin x + \cos x$ (D) None of these

Q.89 The line $2px + y\sqrt{1-p^2} = 1$, $(|p| < 1)$ for different values of p, touches :

(A) an ellipse of eccentricity $\sqrt{3}/2$

(B) an ellipse of eccentricity $1/\sqrt{3}$

(C) a hyperbola of eccentricity 2

(D) an ellipse or a hyperbola depending on p

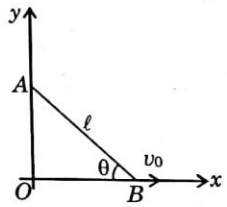
Q.90 If $A^3 = O$, then $I + A + A^2$ equals :

(A) $I - A$ (B) $(I-A)^{-1}$

(C) $(I+A)^{-1}$ (D) None of these

PHYSICS

Q.91 In the figure given below, the end B of the rod AB which makes angle θ with the floor is pulled with a constant velocity v_0 as shown. The length of rod is ℓ. At an instant when $\theta = 37°$ -



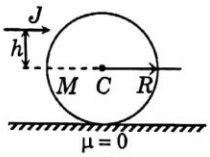
(A) Velocity of end A is $\frac{4v_0}{3}$

(B) angular velocity of rod is $\frac{5v_0}{6\ell}$

(C) angular velocity of rod is constant

(D) velocity of end A is constant

Q.92 A solid sphere of mass M and radius R is placed on a smooth horizontal surface. It is given a horizontal impulse J at a height h above the centre of mass and sphere starts rolling then, the value of h and speed of centre of mass are -



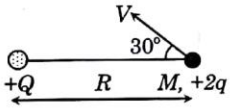
(A) $h = \frac{2}{5}R$ and $v = \frac{J}{M}$

(B) $h = \frac{2}{5}R$ and $v = \frac{2}{5}\frac{J}{M}$

(C) $h = \frac{7}{5}R$ and $v = \frac{7}{5}\frac{J}{M}$

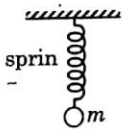
(D) $h = \frac{7}{5}R$ and $v = \frac{J}{M}$

Q.93 In the diagram shown, the charge + Q is fixed. Another charge $+2q$, is projected from a distance R from the fixed charge. Minimum separation between the two charges if the velocity becomes $\frac{1}{\sqrt{3}}$ times of the projected velocity, at this moment is (Assume gravity to be absent) -



(A) $\frac{\sqrt{3}}{2}R$ (B) $\sqrt{3}R$ (C) $\frac{1}{2}R$ (D) $4R$

Q.94 If force constant of spring is $k = \frac{2mg}{\ell}$ and now mass m is displaced down ward from equilibrium and released. Then time period will be -



(A) $2\pi\sqrt{\frac{\ell}{2g}}$ (B) $2\pi\sqrt{\frac{\ell}{g}}$

(C) $\frac{4\pi}{3}\sqrt{\frac{\ell}{2g}}+\sqrt{\frac{6\ell}{g}}$ (D) $\pi\sqrt{\frac{\ell}{2g}}+\sqrt{\frac{8\ell}{g}}$

Q.95 At $t = 0$ the no of active nuclei in radioactive is number is N_0 if decay constant is λ and rate of formation of isotope is K. Then number of active nuclei-

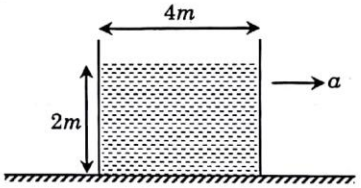
(A) first increases then decreasing

(B) goes on increasing

(C) goes on decreasing

(D) is $\frac{K}{\lambda}$ after long time

Q.96 A container of dimension $4m \times 3m \times 2m$ starts to move with uniform acceleration $a = 1.25$ m/s^2 at $t = 0$. The volume of liquid in vessel is 18 m^3. The speed of liquid coming out from a very small orifice made at bottom of right side wall just after acceleration of container -



(A) zero (B) $\sqrt{30}$ m/sec

(C) 5 m/s (D) 10 m/s

Q.97 120 g of ice at 0°C is mixed with 100 g of water at 80°C. Latent heat of fusion is 80 cal/g and specific heat of water is 1 cal/g°C. The final temperature of the mixture is -

(A) 0°C (B) 40°C

(C) 20°C (D) 10°C

Q.98 A stone of mass 1 kg is tied to a string 4 m long and is rotated at constant speed of 40 ms^{-1} in a vertical circle. The ratio of the tension at the top and the bottom is-

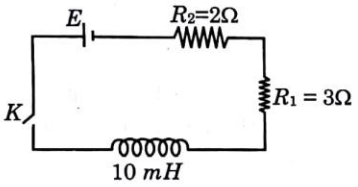
(A) 11 : 12 (B) 39 : 41

(C) 41 : 39 (D) 12 : 11

Q.99 A magnet is suspended in the magnetic meridian with an untwisted wire. The upper end of the wire is rotated through 180° to deflect the magnet by 30° from magnetic meridian. Now this magnet is replaced by another magnet and the upper end of the wire has to be rotated through 270° to deflect the magnet by 30° from magnetic meridian. The ratio of magnetic moments of the two magnet is -

(A) 1 : 1 (B) $\frac{2}{3}$ (C) $\frac{3}{2}$ (D) $\frac{5}{8}$

Q.100 The time at which current in R_2 becomes half of the steady value of current when the circuit is switched on at $t = 0$:



(A) 1.03 ms (B) 1.40 ms
(C) 2.09 ms (D) 3.19 ms

CHEMISTRY

Q.101 A hypothetical reaction :

$A_2 + B_2 \rightarrow 2AB$ Follows mechanism as given below :

$A_2 \underset{}{\overset{k_c}{\rightleftharpoons}} A + A$ ..... (fast)

$A + B_2 \underset{}{\overset{k_1}{\rightleftharpoons}} AB + B$ ..... (slow)

$A + B \underset{}{\overset{k_2}{\rightleftharpoons}} AB$ ..... (fast)

The order of overall reaction is :

(A) 2.5 (B) 1 (C) 3/2 (D) Zero

Q.102 You are given the following cell at 298 K,

$$Zn \left| \begin{matrix} Zn^{++}_{(aq.)} \\ 0.01M \end{matrix} \right| \left| \begin{matrix} HCl(aq.) \\ 1.0 lit \end{matrix} \right| \left| \begin{matrix} H_2(g) \\ 1.0\ atm \end{matrix} \right| Pt$$

With $E_{cell} = 0.701$ and $E^0_{Zn^{2+}/Zn} = -0.76$ V.

Which of the following amounts of NaOH (equivalent weight = 40) will just make the pH of cathodic compartment to be equal to 7. 0 :

(A) 0.4 gms (B) 4 gms
(C) 10 gms (D) 2 gms

Q.103 The ground state electronic configuration of the elements, *U*, *V*, *W*, *X*, *Y* and *Z* are as follows :

U $1s^2 2s^2 2p^3$
V $1s^2 2s^2 2p^6 3s^1$
W $1s^2 2s^2 2p^6 3s^2 3p^2$
X $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$
Y $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$

Determine which sequence of elements best fits the following statements :

(i) element-forms a carbonate which is not decompoased by heating

(ii) element is most likely to form coloured ionic compounds

(iii) element is a monoatomic gas

	(i)	(ii)	(iii)
(A)	V	X	Y
(B)	V	Y	U
(C)	U	Y	X
(D)	W	X	Y

Q.104 The maximum radius of an atom which can occupy empty spaces (voids) in a body cantred structure, of an element having atomic radius *R*, without causing any distortion, can be :

(A) $\left(\frac{2-\sqrt{3}}{\sqrt{3}}\right)$R (B) $\left(\sqrt{\frac{5}{3}}-1\right)$R

(C) $\left(\sqrt{\frac{4}{3}}-1\right)$R (D) $(\sqrt{2} - 1)$R

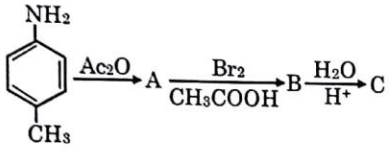
Q.105 How many moles of sucrose should be dissolved in 500 gms of water so as to get a solution which has a difference of 104°C between boiling point and freezing point. (K_f=1.86 K kg mol^{-1}, K_b=0.52 K Kg mol^{-1})

(A) 1.68 (B) 3.36 (C) 8.40 (D) 0.840

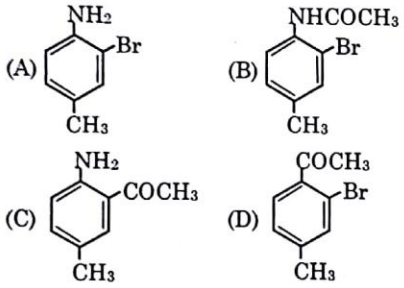
Q.106 For the decomposition of H_2O_2 (aq) it was found that V_{O_2} (t = 15 min.) was 100 mL (at 0°C and 1 atm) while V_{O_2} (maximum) was 200 mL (at 0°C and 2 atm) If the same reaction had been followed by the titration method and if $V_{KMnO_4}^{(CM)}$ (t = 0) had been 40 mL, what would $V_{KMnO_4}^{(cM)}$ (t = 15 min) have been ?

(A) 30 mL (B) 25 mL
(C) 20 mL (D) 15 mL

Q.107 The final product C, obtained in this reaction



would be :



Q.108 Consider the following statements in respect of the reaction

$$(CH_3)_3CBr + \bar{O}H \xrightarrow{Alcohol} (CH_3)_3COH + Br^-$$

1. It is a nucleophilic substitution
2. It is a two-step reaction
3. The rate of the reaction depends only on the concentration of the alkyl halide
4. It is an S_N2 reaction
5. Carbocation intermediate is formed in this reaction.

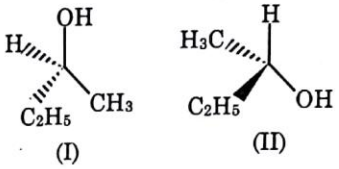
Which of the above statement are correct ?

(A) 1, 2, 3 and 5 (B) 1, 2 and 5 only
(C) 3 and 4 only (D) 2, 3 and 4

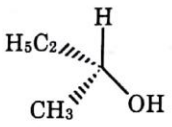
Q.109 Additon of Br_2 to 1-pentene would produce 1, 2-dibromopentane which is :

(A) meso (B) achiral
(C) optically active (D) racemic

Q.110 Consider the following compounds :



(I) (II)



(III)

Which one of the following is correct in respect of the above compounds ?

(A) I and II are enantiomers
(B) I and III are enantiomers
(C) II and III are identical
(D) I and III are identical

BIOLOGY

Q.111 The energy required to hydrolyse water during photosynthesis comes from -

(A) Reduced chlorophyll
(B) Proton gradient
(C) Coxidised chlorophyll
(D) ATP

Q.112 60% of the angiospmers shed their pollens at the -

(A) 2-celled stage (B) 3-celled stage
(C) 4-celled stage (D) 1-celled stage

Q.113 The genotypic ratio of a monohybrid cross in F_2-generatin is -

(A) 3 : 1 (B) 1 : 2 : 1
(C) 2 : 1 : 1 (D) 9 : 3 : 3 : 1

Q.114 *A.* $\frac{X}{A} = 1$

B. $\frac{X}{A}$ > more than 1

C. $\frac{X}{A} = 0.5$

Here, X = number of X-chromosome

A = set of autosomal pair

Choose the correct option for *A*, *B* and *C* result.

(A) *A*– female, *B*– meta female, *C*– male

(B) *A*– female, *B*– meta female, *C*– female

(C) *A*– female, *B*– female, *C*– male

(D) *A*– meta female, *B*– female, *C*– male

Q.115 Point mutation involves -

(A) Insertion

(B) Change in single base pair

(C) Duplication

(D) Deletion

Q.116 *Triticale* has been produced by the intergenic hybridization of -

(A) Wheat and rice

(B) Wheat and rye

(C) Wheat and aegilops

(D) Rice and maize

Q.117 Haploid content of human DNA has -

(A) 3.3×10^7 bp (B) 3.3×10^8 bp

(C) 3.3×10^9 bp (D) 3.3×10^{10} bp

Q.118 Splicing is the removal of -

(A) Exons end exons are joined

(B) Introns end exons are joined

(C) Exons only

(D) Intron only

Q.119 The accessibility of the promoter regions of prokaryotic DNA is (in many cases) regulated by the interaction of proteins with the sequences termed as -

(A) Regulator (B) Promoter

(C) Operator (D) Structural genes

Q.120 Enzyme that is used in PCR technology is-

(A) Ligase

(B) Polymerase

(D) Helicase

(D) Reverse transcriptase

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-8

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 Distance of the point $P(2, -3, 4)$ from plane $\vec{r}.(\hat{i} + \hat{j} + \hat{k}) = 5$ measured parallel to x-axis, is :

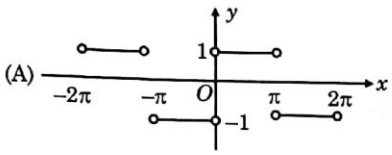
(A) 1 (B) $\sqrt{2}$ (C) 2 (D) 4

Q.2 Average length of all vertical chords of the curve $y = \sqrt{4 - x^2}$ is :

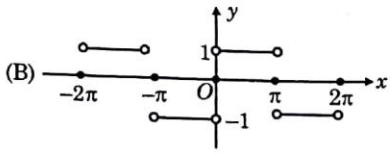
(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{8}$ (D) π

Q.3 Graph of $y = \frac{|\sin x|}{\sin x}$ is :

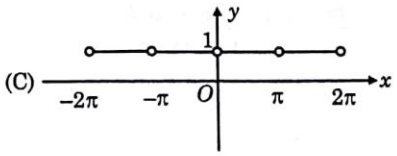
(A)



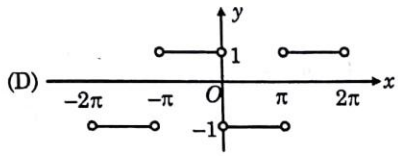
(B)



(C)



(D)



Q.4 The function $f(x) = \begin{cases} [x] + \sqrt{x - [x]} & \text{for } x \geq 0 \\ \sin x & \text{for } x < 0 \end{cases}$ is :

(A) cont. only for all non-negative integers

(B) cont. only for all positive integers

(C) discont. Only for all negative integers

(D) cont. for all real numbers

Q.5 Let $f(x) = \begin{vmatrix} 2\cos^2 x & \sin(2x) & -\sin x \\ \sin 2x & 2\sin^2 x & \cos x \\ \sin x & -\cos x & 0 \end{vmatrix}$ then $\int_0^{\pi/2} [f(x) + f'(x)]dx =$

(A) π (B) $\pi/2$ (C) 2π (D) zero

Q.6 If $A + B + C = \pi$, then the value of the determinant $D = \begin{vmatrix} \sin^2 A & \cot A & 1 \\ \sin^2 B & \cot B & 1 \\ \sin^2 C & \cot C & 1 \end{vmatrix} =$

(A) 1 (B) –1

(C) 0 (D) None of these

Q.7 The function $f : R \to R$ is defined by $f(x) = -x^3 + 2ax^2 - 3bx + c$, where $a, b, c \in R$, is a bijective function. If $4a^2 \leq kb$, then value of k may be :

(A) 11 (B) 13

(C) 17 (D) All of these

Q.8 $\int \sqrt{x-3}\ (\sin^{-1} \ell n\ x + \cos^{-1} \ell n\ x)\ dx$ is equal to :

(A) $\frac{\pi}{3}(x-3)^{3/2} + c$ (B) 0

(C) does not exist (D) None of these

Q.9 If $x < 0$, then $\tan^{-1}\left(\frac{1}{x}\right) =$

(A) $\cot^{-1} x$ (B) $\pi + \cot^{-1} x$

(C) $\pi - \cot^{-1} x$ (D) $-\pi + \cot^{-1} x$

Q.10 $\lim_{x \to \infty} \frac{\log_e [x]}{x}$ where [ ] denotes the greatest integer function is :

(A) 0 (B) 1

(C) –1 (D) not-existent

Q.11 If $p > 2$ then the maximum value of the function $f(x) = \cos 2x + 2p \sin x$ is :

(A) $2p - 3$ (B) –1

(C) $-3 - 2p$ (D) $-1 + 2p$

Q.12 If the function $f(x)$ increases in the interval (a, b) then the function $\phi(x) = [f(x)]^2$:

(A) increases in (a, b)

(B) decreases in (a, b)

(C) we cannot say that $\phi(x)$ increases or decreases in (a, b)

(D) None of these

Q.13 An isosceles triangle is chosen from all the triangle whose vertices are chosen from the vertices of a cube. If the probability that the chosen triangle is equilateral is p, then find the value of $840\ p$.

(A) 210 (B) 410

(C) 230 (D) 240

Q.14 Number of possible ordered pair(s) (a, b) for each of which the equality $a(\cos x - 1) + b^2 = \cos(ax + b^2) - 1$ holds true for all $x \in R$ are :

(A) 0 (B) 1

(C) 2 (D) Infinite

Q.15 If $a, \alpha_1, \alpha_2 \ldots \alpha_{2n-1}, b$ are in A.P., $a, \beta_1, \beta_2, .., \beta_{2n-1}, b$ are in G.P. and $a, \gamma_1, \gamma_2, .. \gamma_{2n-1}, b$ are in H.P., where a, b are positive, then the equation $\alpha_n x^2 - \beta_n x + \gamma_n = 0$ has :

(A) real and equal roots

(B) real and unequal roots

(C) imaginary roots

(D) roots which are in A.P.

Q.16 The limiting position of the point of intersection of the straight lines, $3x + 5y = 1$ and $(2 + c)x + 5c^2y = 1$ as c tends to one is :

(A) $\left(\frac{2}{5}, -\frac{1}{25}\right)$

(B) $\left(\frac{1}{2}, -\frac{1}{10}\right)$

(C) $\left(\frac{3}{8}, -\frac{1}{40}\right)$

(D) None of these

Q.17 The set of values of p for which the equation $|\ell n\, x| - px = 0$ possess three roots is :

(A) $(0, 1/e)$ (B) $(0, 1)$

(C) $(0, \sqrt{3})$ (D) $(0, e)$

Q.18 The equation $|\sin x| = \sin x + 3$ has in $[0, 2\pi]$

(A) no root

(B) only one root

(C) two roots

(D) more than two roots

Q.19 $\frac{\tan 2\alpha + \tan 3\alpha - \tan 5\alpha}{\tan 2\alpha . \tan 3\alpha . \tan 5\alpha} = ?$

(A) $\tan \alpha$ (B) $\cot \alpha$

(C) -1 (D) 1

Q.20 If $\vec{p} = 3\vec{a} - 5\vec{b}$; $\vec{q} = 2\vec{a} + \vec{b}$; $\vec{r} = \vec{a} + 4\vec{b}$; $\vec{s} = -\vec{a} + \vec{b}$ are four vectors such that $\sin(\vec{p} \wedge \vec{q}) = 1$ and $\sin(\vec{r} \wedge \vec{s}) = 1$ then $\cos(\vec{a} \wedge \vec{b})$ is :

(A) $-\frac{19}{5\sqrt{43}}$ (B) 0

(C) $\frac{19}{5\sqrt{43}}$ (D) 1

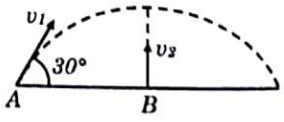
PHYSICS

Q.21 The height at which the acceleration due to gravity becomes $g/9$ (where g acceleration due to gravity on the surface of the earth) in terms of the radius of the earth, R is -

(A) $R/\sqrt{2}$ (B) $R/2$

(C) $\sqrt{2}\,R$ (D) $2\,R$

Q.22 A body is projected with velocity v_1 from the point A as shown in figure. At the same time, another body is projected vertically upwards from B with velocity v_2. The point B lies vertically below the highest point. For both the bodies to collide, minimum value of $\frac{v_2}{v_1}$ should be -



(A) 2 (B) 0.5

(C) $\sqrt{3/2}$ (D) 1

Q.23 A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium if q is equal to –

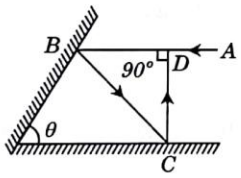
(A) $-\frac{Q}{2}$ (B) $-\frac{Q}{4}$ (C) $+\frac{Q}{2}$ (D) $+\frac{Q}{4}$

Q.24 A point moves in a straight line under the retardation $b\ v^2$. If the initial velocity is u, the distance covered in t seconds is -

(A) $b \log b\ ut$ (B) $\frac{1}{b} \log b\ ut$

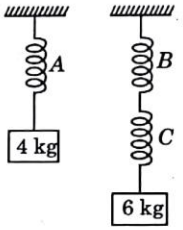
(C) $\frac{1}{b} \log (1 + b\ ut)$ (D) $\frac{1}{b} \log (1 - b\ ut)$

Q.25 Two plane mirrors are inclined at angle θ. An optical ray AB is incident on a mirror at an angle 2θ with the mirror, as shown. The reflected ray from the second mirror, CD is perpendicular to the incident ray, find angle θ -



(A) 60° (B) 45° (C) 75° (D) 30°

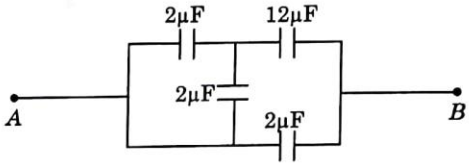
Q.26 Figure shows three identical springs A, B, C. When a 4 kg weight is hung on A, it descends by 1 cm. When a 6 kg weight is hung on C, it will descend by -



(A) 1.5 cm (B) 3.0 cm

(C) 4.5 cm (D) 6.0 cm

Q.27 Four capacitors are connected as shown in the figure. The effective capacitance between the points A and B will be –

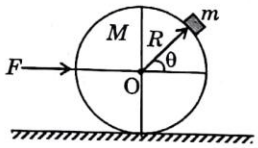


(A) $\frac{28}{9}$ μF (B) 4 μF (C) 5 μF (D) 18 μF

Q.28 A spring of force constant k is cut into two equal halves. The force constant of each half is –

(A) $k/\sqrt{2}$ (B) $k/2$ (C) k (D) $2k$

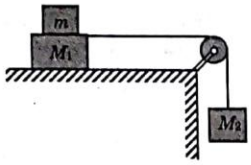
Q.29 A smooth sphere of radius R and mass M is placed on the smooth horizontal floor. Another smooth particle of mass m is placed on the sphere and a horizontal force F is applied on the sphere as shown. If the particle does not slip on the sphere then the value of force F is -



(A) $F = mg \cot\theta$ (B) $F = Mg \cot\theta$

(C) $F = (m + M)g \cot\theta$ (D) $F = (m + M)g \tan\theta$

Q.30 Two blocks of masses M_1 and M_2 are connected with a string passing over a pulley as shown in figure. The block M_1 lies on a horizontal surface. The coefficient of friction between the block M_1 and the horizontal surface is μ. The system accelerates. What minimum additional mass m should be glued on the block M_1 so that the system does not accelerate? [There is no relative motion between M_1 and m] -



(A) $\frac{M_2 - M_1}{\mu}$

(B) $\frac{M_2}{\mu} - M_1$

(C) $M_2 - \frac{M_1}{\mu}$

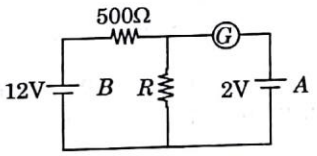
(D) $(M_2 - M_1)\mu$

Q.31 An ideal diatomic gas occupies a volume V_1 at a pressure P_1. The gas undergoes a process in which the pressure is proportional to the volume. At the end of process the rms speed of the gas molecules has doubled from its initial value then the heat supplied to the gas in the given process is -

(A) $7\,P_1V_1$ (B) $8\,P_1V_1$

(C) $9\,P_1V_1$ (D) $10\,P_1V_1$

Q.32 In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be –



(A) 500 Ω (B) 1000 Ω

(C) 200 Ω (D) 100 Ω

Q.33 An ideal gas is expanded so that amount of heat given is equal to the decrease in internal energy. The gas undergoes the process $TV^{1/5}$ = constant. The adiabatic compressibility of gas when pressure is P, is-

(A) $\frac{7}{5P}$ (B) $\frac{5}{7P}$ (C) $\frac{2}{5P}$ (D) $\frac{7}{3P}$

Q.34

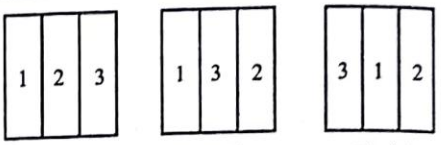


Fig.(a) Fig.(b) Fig.(c)

Figure (a), (b), (c) shows three different arrangements of materials 1, 2 and 3 to form a wall. Thermal conductivities are $K_1 > K_2 > K_3$. The left side of the wall is 20°C higher than the right side. Temperature difference ΔT across the material 1 has following relation, in three cases -

(A) $\Delta T_a > \Delta T_b > \Delta T_c$ (B) $\Delta T_a = \Delta T_b = \Delta T_c$

(C) $\Delta T_a = \Delta T_b > \Delta T_c$ (D) $\Delta T_a = \Delta T_b < \Delta T_c$

Q.35 If a long hollow copper pipe carries a direct current, the magnetic field associated with the current will be -

(A) only inside the pipe

(B) only outside the pipe

(C) both inside and outside the pipe

(D) neither inside nor outside the pipe

Q.36 In young double slit experiment $\frac{d}{D} = 10^{-4}$ and wavelength of light is used 6000Å. At a point P on the screen resulting intensity is equal to the intensity due to individual slit I_0. Then the distance of point P from the central maximum is –

(A) 2 mm (B) 1 mm

(C) 0.5 mm (D) 4 mm

Q.37 When a bar magnet falls through a long hollow metal cylinder fixed with its axis vertical, the final acceleration of the magnet is -

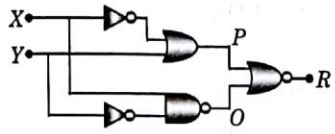
(A) equal to g

(B) less than g but finite

(C) greater than g

(D) equal to zero

Q.38 Figure gives a system of logic gates. From the study of truth table it can be found that to produce a high output (1) at R, we must have -



(A) $X = 0, Y = 1$ (B) $X = 1, Y = 1$
(C) $X = 1, Y = 0$ (D) $X = 0, Y = 0$

Q.39 If the K_α radiation of Mo ($Z = 42$) has a wavelength of 0.71 Å the wavelength of the corresponding radiation for $Cu(Z = 29)$ is -

(A) 1 Å (B) 2 Å
(C) 1.52 Å (D) 2.25 Å

Q.40 The equation of stationary wave is $y = 4\sin\left(\frac{\pi x}{15}\right)\cos(96\pi t)$. The distance between a node and its next antinode is -

(A) 7.5 units (B) 1.5 units
(C) 22.5 units (D) 30 units

CHEMISTRY

Q.41 Two Ist order reactions have half-lives in the ratio 3 : 2. Then the ratio of time intervals $t_1 : t_2$, will be ? Where t_1 is the time period for 25% completion of the first reaction and t_2 is time required for 75% completion of the second reaction. [log 2 = 0.3, log 3 = 0.48]

(A) 0.2 : 1 (B) 0.42 : 1
(C) 0.28 : 1 (D) 0.3 : 1

Q.42 Decomposition of A follows first order kinetics by the following equation,

$4A(g) \rightarrow B(g) + 2C(g)$

If initially, total pressure was 800 mm of Hg and after 10 minutes it is found to be 650 mm of Hg. What is half-life of A ? (Assume only A is present initially)

(A) 10 mins (B) 5 mins
(C) 7.5 mins (D) 15 mins

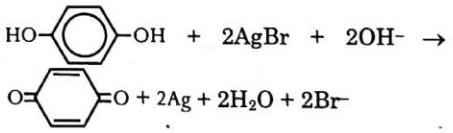
Q.43 Which of the following names is impossible :

(A) Potassium tetrafluorooxochromate (VI)
(B) Barium tetrafluorobromate (III)
(C) Dichlorobis (urea) copper (II)
(D) All are impossible

Q.44 Which of the following pair of complexes have the same EAN of the central metal atoms/ions ?

(A) $[Cu(NH_3)_4]SO_4$ and $K_3[Fe(CN)_6]$
(B) $K_4[Fe(CN)_6]$ and $[Co(NH_3)_6]Cl_3$
(C) $K_3[Cr(C_2O_4)_3]$ and $[Ni(CO)_4]$
(D) All of the above

Q.45 In photography, quionole is used as developer according to following reaction.



Which of the following describe(s) the rule of quinol in this reaction.

(A) It acts as an acid
(B) It acts as a weak base
(C) It acts as an oxidizing agent
(D) It acts as a strong base

Q.46 Electrolysis of a solution of HSO_4^- ion produces $S_2O_8^{--}$. Assuming 75% current efficiency, what current should be employed to achieve a production rate of 1 mole of $S_2O_8^{--}$ per hour ?

(A) +71.5 amp (B) 35.7 amp
(C) 142.96 amp (D) 285.93 amp

Q.47 In the reaction sequence

$CrO_2Cl_2 \xrightarrow{NaOH} A \xrightarrow{dil\ H_2SO_4} B \xrightarrow{NaOH} C \xrightarrow{AgNO_3} D$

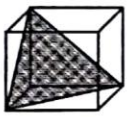
(A) A = Na_2CrO_4; B = $Na_2Cr_2O_7$; C = Na_2CrO_4; D = Ag_2CrO_4

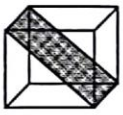
(B) A = Na_2CrO_4; B = $Na_2Cr_2O_7$; C = $Na_2Cr_2O_7$; D = $Ag_2Cr_2O_7$

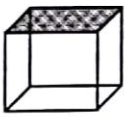
(C) A = $Na_2Cr_2O_7$; B = Na_2CrO_4; C = $Na_2Cr_2O_7$; D = $Ag_2Cr_2O_7$

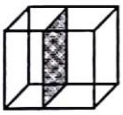
(D) A = C = Na_2CrO_4; D = $Ag_2Cr_2O_7$, B = $Na_2Cr_2O_7$

Q.48 In an f.c.c. crystal, which of the following shaded planes contains the following type of arrangement of atoms ?

(A) 

(B) 

(C) 

(D) 

Q.49 A solution of 0.2 mole KI (α = 100%) in 1000 g water freezes at T_1 °C. Now to this solution 0.1 mole HgI_2 is added and the resulting solution freezes at T_2 °C. Which of the following is correct :

(A) $T_1 = T_2$

(B) $T_1 > T_2$

(C) $T_1 < T_2$

(D) Can't be say

Q.50 Which of the following ions will be most effective in coaogulating the As_2S_3 sol :

(A) Fe^{3+} (B) Ba^{2+}

(C) Cl^- (D) PO_4^{3-}

Q.51 Which of the following species does not exist

(A) Cl_4 (B) $[SiO_4]^{4-}$

(C) $[CO_4]^{4-}$ (D) C_2

Q.52 Which is correct regarding the cyclic trimer of SO_3

(A) It contains three S – S, σ bonds

(B) It contains three O – O, σ bonds

(C) It contains six O – O, π bonds

(D) The total number of σ and π bonds in it are 12 and 6 respectively

Q.53 For H_3PO_3 and H_3PO_4, the correct choice is :

(A) H_3PO_3 is stronger acid than H_3PO_4

(B) H_3PO_3 is dibasic and reducing

(C) H_3PO_4 is tribasic and reducing

(D) (A) and (B) both

Q.54 Primary amine reacts with carbon disulphide and $HgCl_2$ to produce alkyl isothiocyanate. This reaction is :

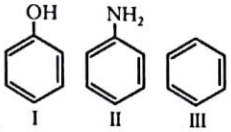
(A) Carbylamine reaction

(B) Hofmann bromide reaction

(C) Perkin reaction

(D) Hofmann mustard oil reaction

Q.55 Consider the following compounds :



I II III

Which of the above compounds will react with bromine water to give tribromo substitution product ?

(A) I and II (B) II only

(C) I and II (D) III only

Q.56 Consider the following ions :

1. NH_2^-
2. Cl^-
3. ClO_4^-
4. CH_3COO^-

What is the correct order of basic strength of the above ions ?

(A) 4 > 1 > 2 > 3 (B) 4 > 3 > 1 > 2

(C) 1 > 4 > 2 > 3 (D) 1 > 4 > 3 > 2

Q.57 Consider the following statements in respect of the reaction

$$Br^- + R\text{–}CH_2 - \overset{+}{O}H_2 \rightarrow Br - CH_2 - R + H_2O$$

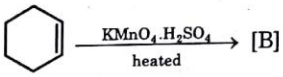
1. Br^- is a nucleophile and protonated alcohol is an electrophile.
2. It is nucleophilic displacement of water from protonated alcohol by Br^- nucleophile

Which of the statements given above is/are correct ?

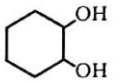
(A) 1 only (B) 2 only

(C) Both 1 and 2 (D) Neither 1 nor 2

Q.58 Consider the following reaction :

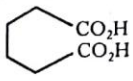


What is the major product [B] of the reaction ?

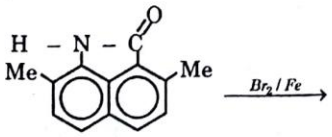
(A) 

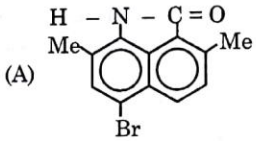
(B) 

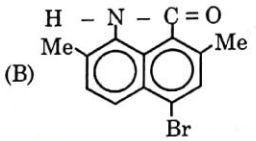
(C) 

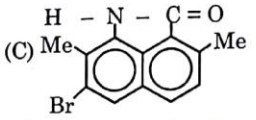
(D) 

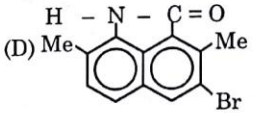
Q.59 Following compound reacts with Br_2/Fe to produce



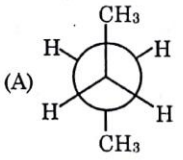
(A) 

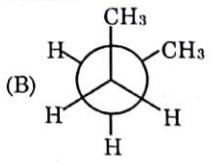
(B) 

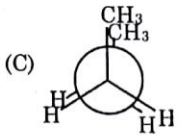
(C) 

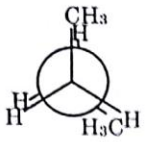
(D) 

Q.60 In the following the most stable conformation of n-butane is :

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.61 Which of the following is correct about ear ossicles ?

(A) They are present in the middle ear

(B) The 3 ear ossicles (malleus, incus and stapes) are attached to one other in a chain-like fashion

(C) Malleus is attached to the ear drum and stepes to the oval window

(D) All

Q.62 Follicle stimulating hormone is secreted by-

(A) Pineal (B) Pituitary

(C) Thymus (D) All of these

Q.63 Under normal condition which one set is completely reabsorbed in the renal tubule-
(A) Urea, uric acid, cretinin
(B) Salt, water, protein
(C) Glucose, aceto acetate, vitamins
(D) All of the above

Q.64 Artificial immunity can be acquired from a -
(A) Serious illness
(B) Vaccination
(C) Repeated exposure to the same microbe
(D) Treatment with penicillin

Q.65 Clitoris in female mammals is -
(A) Homologous to penis
(B) Analogous to penis
(C) Functional penis in female
(D) Non-functional penis in male

Q.66 Birth control pills check ovulation in female by inhibiting the secretion of -
(A) Progestogen (B) Estrogen
(C) Both (D) None of these

Q.67 Class crustacea possesses following features -
(A) cephalothorax, biramous appendages and gills
(B) head, thorax, biramous appendages and book-lungs
(C) head, thorax, book-lungs and chitinous exoskeleton
(D) cephalothorax, book-lungs and chitinous exoskeleton

Q.68 Major part of semen is secreted by -
(A) Seminal vesicle (B) Prostate gland
(C) Cowper's gland (D) Bartholin's gland

Q.69 The most important long acting antibody representing about 80% of the antibody that is able to pass across the placenta is-
(A) 1gD (B) IgG (C) IgM (D) IgA

Q.70 Development of egg without fertilization is called -
(A) oogenesis (B) metagenesis
(C) gametogenesis (D) parthenogenesis

Q.71 In lederberg's replica plating experiment what shall be used to obtain streptomycin resistant strain -
(A) Minimal medium and streptomycine
(B) Complete medium and streptomycine
(C) Only minimal medium
(D) Only complete medium

Q.72 Viable material of endangered species can be preserved by -
(A) Gene bank (B) Gene library
(C) Herbarium (D) Gene pool

Q.73 Most of the mutations are -
(A) Harmful
(B) Harmful and recessive
(C) Beneficial
(D) Dominant

Q.74 In cloning of cattle a fertilized egg is taken out of the mother's womb and -
(A) From this upto eight identical twins can be produced
(B) The egg is divided into 4 pairs of cells which are implanted into the womb of other cows
(C) In the eight cell stage, cells are separated and cultured until small embryos are formed which are implanted into the womb of other cows.
(D) In the eight cell stage the individual cells are separated under electrical field for further development in culture media

Q.75 Pashmina is obtained from a variety of -
(A) Sheep (B) Goat
(C) Yak (D) Rabbit

Q.76 Moss capsule represents a -
(A) Gametophyte
(B) Sporophyte
(C) Part of protonema
(D) Part of sorus

Q.77 Which of the following gymnospermic corolloid roots are associated with N_2-fixing cyanobacteria?
(A) *Pinus* (B) *Cycas*
(C) *Cedrus* (D) *Ginkgo*

Q.78 Comparing small and large cells, which statement is correct ?
(A) Small cells have a small surface area per volume ration
(B) Exchange rate of nutrients is fast with large cells
(C) Small cells have a large surface area per volume ratio
(D) Exchange rate of nutrients is slow with small cells

Q.79 The cell division seen in somatic cells line is called ...*A*..., while that seen in germ cells line is called ...*B*...
(A) *A*– meiosis; *B*– mitosis
(B) *A*– mitosis; *B*– meiosis
(C) *A*– amitosis; *B*– meiosis
(D) A– meiosis; *B*– amitosis

Q.80 Light reaction or photochemical phase includes -
I. Light absorption
II. Water splitting
III. Oxygen release
IV. ATP and NADP formation
Select the correct option.
(A) I, II and IV (B) I, II and III
(C) I, III and IV (D) I, II, III and IV

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 Find the number of solutions of $2^x + 3^x + 4^x - 5^x = 0$.
(A) one (B) two
(C) three (D) no solution

Q.82 A rhombus *ABCD* has sides of length 8 cm. A circle with centre '*A*' passes through *C* (opposite vertex). Also a circle with centre *B* passes through *D*. If two circles are tangent to each other, then area of rhombus-
(A) 75 sq.units (B) 48 sq.units
(C) 30 sq.units (D) None of these

Q.83 Given ΔABC is inscribed in the semicircle with diameter *AB*. The area of ΔABC equals 2/9 of the area of the semicircle. If the measure of the smallest angle in ΔABC is x, then $\sin 2x$ is equal to -
(A) $\frac{\pi}{9}$ (B) $\frac{2\pi}{9}$ (C) $\frac{\pi}{18}$ (D) $\frac{\pi}{8}$

Q.84 If $15\sin^4\alpha + 10\cos^4\alpha = 6$ then value of $8\,\text{cosec}^6\alpha + 27\sec^6\alpha - 241$ is-
(A) 9 (B) 19 (C) 91 (D) 99

Q.85 Circumcentre is at origin & $a \le \sin A$. $P(x, y)$ lie inside the circumcircle & $k = \frac{1}{8|xy|}$, then least integer value of k can be -
(A) 1 (B) 2 (C) 3 (D) 5

Q.86 In a triangle *ABC*, $\angle A = 60°$, $\angle B = 40°$, & $\angle C = 80°$. If *P* is centre of circumcircle of ΔABC with unity radius, then the radius of circumcircle of ΔBPC is.....
(A) 1 (B) 2 (C) $\sqrt{3}$ (D) $2\sqrt{3}$

Q.87 $\sin x + \cos\left(x - \frac{\pi}{4}\right) + \sqrt{2+\sqrt{2}}$ lies in the interval -
(A) [0, 2] (B) $[0, \sqrt{2+\sqrt{2}}\,]$
(C) $[0, 2\sqrt{2+\sqrt{2}}\,]$ (D) None of these

Q.88 The sum to n terms of the series
$$\left[\frac{1}{1+1^2+1^4} + \frac{2}{1+2^2+2^4} + \frac{3}{1+3^2+3^4} + \ldots\ldots + \frac{n}{1+n^2+n^4}\right]$$ is-
(A) $\frac{n(n+1)}{2(n^2+n+1)}$ (B) $\frac{n(n^2+1)}{2(n^4+n^2+1)}$
(C) $\frac{n(n^2-1)}{2(n^2+n+1)}$ (D) None of these

Q.89 The area bounded by $y \le 3 - |3 - x|$ and $y \ge |x - 3|$ is-

(A) $\frac{5}{2}$ (B) $\frac{9}{2}$

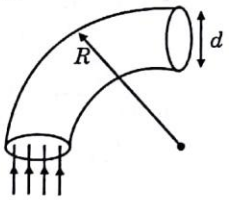
(C) $\frac{7}{2}$ (D) none of these

Q.90 $Arg\ [i^{-53} + \{i^n + i^{n+1} + i^{n+2} + i^{n+3} + 4\}i]$ is -

(A) 0 (B) π (C) $\frac{\pi}{2}$ (D) $-\frac{\pi}{2}$

PHYSICS

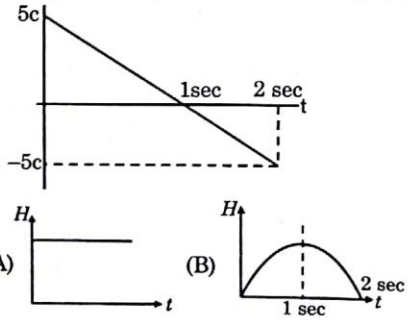
Q.91 A cylindrical optical fibre (quarter circular shape) of refractive index $n = 2$ and diameter $d = 4$mm is surrounded by air. A light beam is sent into the fibre along its axis as shown in figure. Then the smallest outer radius R (as shown in figure) for which no light escapes during first refraction from curved surface of fibre is :

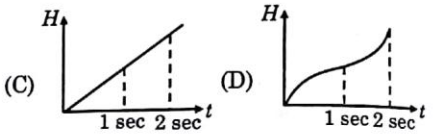


(A) 2 mm (B) 4 mm

(C) 8 mm (D) 6 mm

Q.92 A charge passing through a resistor is varying with time as shown in the figure. The amount of heat generated in time 't' is best represented (as a function of time) by :



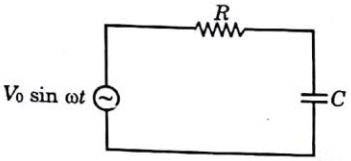


Q.93 In a Young's double slit experiment, $d = 1$ mm, $\lambda = 6000$ Å and $D = 1$m (where d, λ and D have usual meaning). Each of slit individually produces same intensity on the screen. The minimum distance between two points on the screen having 75 % intensity of the maximum intensity is :

(A) 0.45 mm (B) 0.40 mm

(C) 0.30 mm (D) 0.20 mm

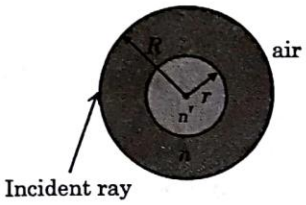
Q.94 An ac voltage source $V = V_0 \sin \omega t$ is connected across resistance R and capacitance C as shown in figure. It is given that $R = \frac{1}{\omega C}$. The peak current is I_0. If the angular frequency of the voltage source is changed to $\frac{\omega}{\sqrt{3}}$ then the new peak current in the circuit is :



(A) $\frac{I_0}{2}$ (B) $\frac{I_0}{\sqrt{2}}$

(C) $\frac{I_0}{\sqrt{3}}$ (D) $\frac{I_0}{3}$

Q.95 A capillary tube is made of glass having index of refraction n and is surrounded by air. The outer radius of the tube is R. The tube is filled with a liquid having index of refraction n' ($n' < n$). For any ray that hits the outer surface of tube from air as shown to also enter the liquid, the minimum internal radius r of the tube is given by :



(A) $r = \frac{R}{n}$ (B) $r = \frac{R}{n'}$

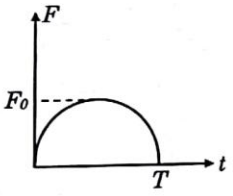
(C) $r = \frac{nR}{n'}$ (D) $r = \frac{n'R}{n}$

Q.96 A stone is thrown horizontally under gravity with a speed of 10 m/sec. Find the radius of curvature of it's trajectory at the end of 3 sec after motion began

(A) $10\sqrt{10}$ m (B) $100\sqrt{10}$ m

(C) $\sqrt{10}$ m (D) 100 m

Q.97 A particle of mass m initially at rest, is acted upon by a variable force F for a brief interval of time T. It attains a velocity u after the force stops acting. F is shown in the graph as a function of time. The curve is a semicircle, find u :



(A) $\frac{\pi F_0^2}{2m}$ (B) $\frac{\pi T^2}{8m}$

(C) $\frac{\pi F_0 T}{4m}$ (D) $\frac{F_0 T}{2m}$

Q.98 The electric potential in a region is given by $V = (2x^2 - 3y)$ volt where x and y are in meters. The electric field intensity at a point (0, 3m, 5m) is :

(A) $-6\hat{i}$ N/C (B) $3\hat{j}$ N/C

(C) $-3\hat{j}$ N/C (D) zero

Q.99 A solid conducting sphere of radius R is moved with a velocity V is a uniform magnetic field of strength B such that $\vec{B}$ is perpendicular to $\vec{V}$. The maximum e.m.f. induced between two points of the sphere is :

(A) $2\,RBV$ (B) RBV

(C) $\sqrt{2}\,RBV$ (D) $\frac{RBV}{2}$

Q.100 A parallel plate capacitor is charged to a potential difference of 100 V and disconnected from the source of emf. A slab of dielectric is then inserted between the plates. Which of the following three quantities change ?

(i) The potential difference

(ii) The capacitance

(iii) The charge on the plates

(A) only (i) and (ii)

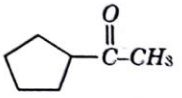
(B) only (i) and (iii)

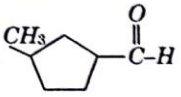
(C) only (ii) and (iii)

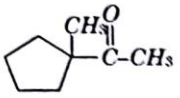
(D) All (i), (ii) and (iii)

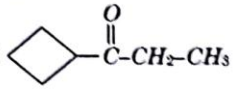
CHEMISTRY

Q.101 Given structure have the same molecular formula i.e. $C_7H_{12}O$. The enol form of which compound will show geometrical isomerism but not optical isomerism -

(A) 

(B) 

(C) 

(D) 

Q.102 $CH_3-CH_2-C\equiv CH \xrightarrow[(ii)\ Br-C_6H_4-CH_2-Cl]{(i)\ NaNH_2} ?$

(A) B-C6H4-CH2-C≡C-CH2-CH3

(B) Cl-CH2-C6H4-C=CH2-CH3

(C) CH3-CH2-C=C-C6H4-CH2-C=C-CH2-CH3

(D) C-C6H4-CH2-C=C-CH2-CH3

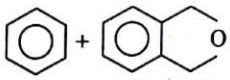
Q.103 $Ph-\underset{18}{O}-CH_3 \xrightarrow[(excess)]{conc.HI}$ Products will be -

(A) $PhOH + CH_3I$ (B) $Ph-\overset{18}{O}H, CH_3I$

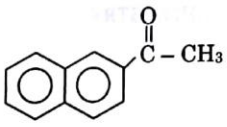
(C) $Ph-I, CH_3\overset{18}{O}H$ (D) PhI, CH_3OH

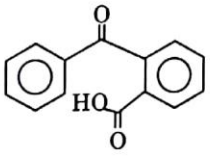
Q.104 cis-2-butene $\xrightarrow{cold.KMnO_4}$ (x) product -

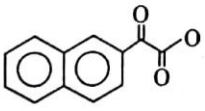
(A) 0 (B) 1 (C) 2 (D) 3

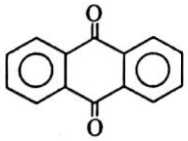
Q.105  $\xrightarrow{AlCl_3}$ (A) Product

(A) is-

(A) 

(B) 

(C) 

(D) 

Q.106 Among cellulose, poly vinyl chloride, nylon and natural rubber, the polymer in which the intermolecular force of attraction is weakest is -

(A) nylon

(B) poly vinyl chloride

(C) cellulose

(D) natural rubber

Q.107 Arenediazonium salts are formed by reaction of-

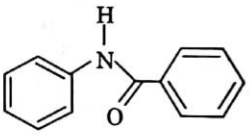
(A) an aromatic amine with hydrogen and palladium

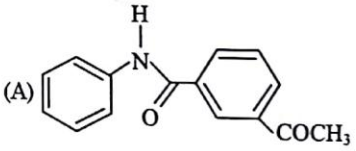
(B) an aromatic amine sodium dichromate

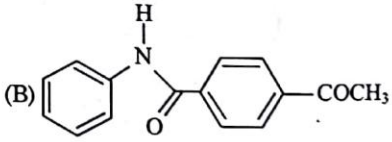
(C) an aromatic amine with nitrous acid

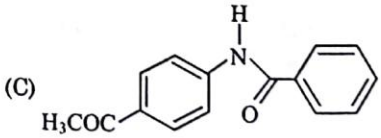
(D) an aromatic amine with potassium nitrosodisulfonate

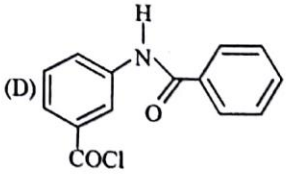
Q.108 Give the major product of the following reaction

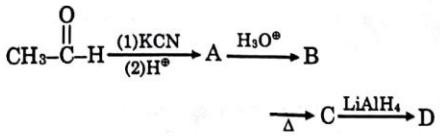
 $\xrightarrow[AlCl_3]{CH_3COCl}$ Major -

(A) 

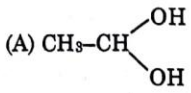
(B) 

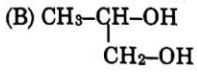
(C) 

(D) 

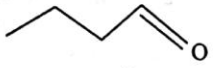
Q.109 

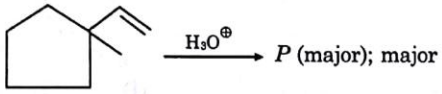
Product D is -

(A) 

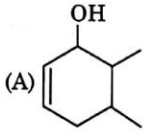
(B) 

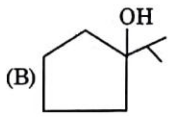
(C) $HO-CH_2-CH_2-CH_2-OH$

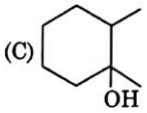
(D) 

Q.110 

P (major); major product is -

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.111 If an insect that eats plant seeds containing 100 jule of energy use 30 jule of that energy for respiration and excretes 20 jule in its faeces, what is the insect's net secondary production ? What is its production efficiency ?

(A) 10 Jule & 10% (B) 40 Jule & 20%

(C) 20 Jule & 40% (D) 40 Jule & 40%

Q.112 Which one of the following organelle in the figure correctly matches with its function ?

(A) Golgi apparatus, protein synthesis

(B) Golgi apparatus, formation of glycolipids

(C) Rough endoplasmic reticulum, protein synthesis

(D) Rough endoplasmic reticulum, formation of glycoproteins

Q.113 If two persons with 'AB' blood group marry and have sufficiently large number of children, these children could be classified as 'A' blood group : 'AB' blood group : 'B' blood group in 1 : 2 : 1 ratio. Modern technique of protein electrophoresis reveals presence of both 'A' and 'B' blood group as 'A' and 'B' type proteins in 'AB' blood group inviduals. This is an example of :

(A) Incomplete dominance

(B) Partial dominance

(C) Complete dominance

(D) Codominance

Q.114 According to the original model of DNA as proposed by Watson & Crick 1953, DNA is a :

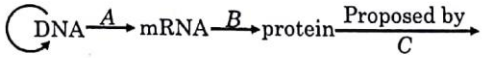
(A) left handed helix

(B) helix that makes a full turn every 70 nm

(C) helix where one turn of DNA contains 20 basepairs

(D) two stranded helix where each strand has opposite polarity

Q.115 The diagram shows an important concept in the genetic implication of DNA. Fill in the blanks *A* to *C*.



(A) A-translation B-transcription C-Erevin Chargaff

(B) A-transcription B-Translation C-Francis Crick

(C) A-translation B-extension C-rosalind Francklin

(D) A-transcription B-replication C-James Watson

Q.116 Choose correct statement

(a) Substained high fever (30° to 40°C), weakeness, stomach pain constipation, headache & loss of appetite are some of the common symptoms of typhoid disease

(b) The rupture of RBCs is associated with release of toxic substance, haemozoin, which is responsible for the chill and high fever recurring every 3-4 days.

(c) Symptoms of ascariasis disease include internal beleeding muscular pain, fever, anaemia & blockage of intestinal passage

(d) Appearance of dry, scaly lesions on various part of body such as skin, nalls and scalp are the main symptoms of viral disease

(A) a & b (B) a, b & c

(C) a, b & d (D) All of these

Q.117 Choose wrong statement

(a) Treatment of AIDS with anti-retroviral drugs is partially effective

(b) Lonising radiaton like x-rays and gamma rays and no-ionising radiation like UV cause DNA damage leading to neoplastic transformation

(c) The side effects of the use of anabolic steroids in females include masculisation (feature like males, increased aggressiveness, mood swings, depression etc.)

(d) Allergy is due to the release of chemicals like histamine & serotonin from the mast cells

(A) a (B) a & b

(C) a, c, d (D) None of these

Q.118 Choose correct statements :

(a) parturition is induced by a complex neuroendcrine mechanism

(b) By end of 24 weeks (second trimesler), the body is covered with fine hair, eye lids separate an eye lashes are formed

(c) The blastomers in the blastocyst are arranged into an outer layer called trophoblast & inner group of cells attached to trophoblast called the inner cell mass

(d) The excretion of the acrosome help the sperm enter into the cytoplasm of the ovum through the zone pellucida and the plasma membrane.

(A) a (B) b, c

(C) a, c, d (D) All of these

Q.119 Select the correct statement from the following

(A) Methanobacterium is aerobic bacterium found in rumen of cattle

(B) Biogas, commonly called gobar gas, is pure methane

(C) Activated sludge-sediment in settlement tanks of sewage treatment plant is rich source of aerobic bacteria

(D) Biogas is produced by the activity of aerobic bacteria on animal waste

Q.120 Which one of the following pairs of items correctly belongs to the category of organs mentioned against it ?

(A) thorn of *Bougainvillea* and tendrils of *Cucurbita* - analogous organs

(B) nictitating membrane and blind spot in human eye - vestigial organs

(C) nephridia of earthworm and Malpighian tubules of cockroach - excretory organs

(D) wings of honey bee and wings of crow - homologous organs

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-9

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 The remainder when $(2222)^{5555} + (5555)^{2222}$ is divided by 7 is :

(A) 0 (B) 2

(C) 4 (D) 5

Q.2 If $|z| = 1$ then maximum value of $|z + \cos\alpha - i\sin\alpha| + |z - \cos\alpha - i\sin\alpha|$ where α is a constant :

(A) 2 (B) $2\sqrt{2}$

(C) 4 (D) 1

Q.3 The sequence $\{x_1, x_2, ..., x_{50}\}$ has the property that for each k, x_k is k less than the sum of other 49 numbers. The value of 96. x_{20} is :

(A) 300 (B) 315 (C) 1024 (D) 0

Q.4 If maximum value of $5\sin\theta + 3\sin(\theta - \alpha) = 3$ is equal to 10 for some $\theta \in R$, then the set of possible values of α is :

(A) $2n\pi \pm \frac{\pi}{3}, n \in I$ (B) $2n\pi \pm \frac{2\pi}{3}, n \in I$

(C) $\left[\frac{\pi}{3}, \frac{2\pi}{3}\right]$ (D) $n\pi + (-1)^n \frac{\pi}{3}, n \in I$

Q.5 If circum radius and inradius of triangle be 8 and 3 then $\sum \frac{a}{\tan A}$ equal to :

(A) 10 (B) 11 (C) 20 (D) 22

Q.6 If $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{b} = \hat{i} + \hat{j}$ and $\vec{c}$ is a vector such that $\vec{a}.\vec{c} = |\vec{c}|$, $|\vec{c} - \vec{a}| = 2\sqrt{2}$ and the angle between $\vec{a} \times \vec{b}$ & $\vec{c}$ is 30°, then the value of $|(\vec{a} \times \vec{b}) \times \vec{c}|$ is :

(A) $\frac{1}{2}$ (B) 1 (C) $\frac{3}{2}$ (D) 2

Q.7 $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$, $\vec{r}$ is a vector in the plane of $\vec{b}$ & $\vec{c}$ whose projection on $\vec{a}$ is of the magnitude $\sqrt{\frac{2}{3}}$ then $\vec{r}$ can be :

(A) $2\hat{i} + 3\hat{j} - 3\hat{k}$ (B) $2\hat{i} + \hat{j} + 5\hat{k}$

(C) $2\hat{i} + 3\hat{j} + 3\hat{k}$ (D) $\hat{i} + \hat{j} + \hat{k}$

Q.8 If f is a non-zero real valued function, such that for any real x, $f(k + x) = f(k - x)$ and $f(2k + x) = -f(2k - x)$ for some $k > 0$ then

(A) f is even and periodic

(B) f is odd but not periodic

(C) f is odd and periodic

(D) f is even but not periodic

Q.9 Let $P(x)$ be a polynomial of degree 4 having extremus at $x = 1$, 2 and $\lim_{x \to 0}\left(1 + \frac{P(x)}{x^2}\right) = 2$. Then the value of $P(2)$ is :

(A) 0 (B) 1 (C) 2 (D) 3

Q.10 A and B start swimming simultaneously from two points P and Q respectively, on a river towards each other. A crosses a floating cork at a point S and B crosses the floating cork at a point T which is at a distance of 8 km from point S. A and B cross each other at a distance of 2 km from T. It is given that the direction of flow of the river is from P to Q and in still water, the ratio of speeds of A and B is 3 : 1. P, S, T and Q (in that order) are on the same straight line and assume that A, B and the floating cork move along that line.

Find the ratio of the upstream speed of A to the downstream speed of B

(A) 9 : 7

(B) 6 : 5

(C) 5 : 4

(D) Cannot be determined

Q.11 If $f(x) + 2f(1 - x) = x^2 + 2$, $x \in R$, then $f(x)$ is given by :

(A) $\frac{(x-1)^2}{3}$ (B) $\frac{(x-2)^2}{3}$

(C) $x^2 - 1$ (D) $x^2 - 2$

Q.12 Area of the region in which point $P(x, y)$, $\{x > 0\}$ lies; such that $y \le \sqrt{16 - x^2}$ and $\left|\tan^{-1}\left(\frac{y}{x}\right)\right| \le \frac{\pi}{3}$ is :

(A) $\left(\frac{16}{3}\pi\right)$ (B) $\left(\frac{8\pi}{3} + 8\sqrt{3}\right)$

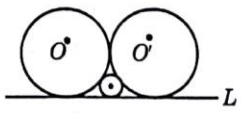
(C) $(4\sqrt{3} - \pi)$ (D) $(\sqrt{3} - \pi)$

Q.13 A spherical rain drop evaporates at a rate proportional to its surface area at that instant. The radius of the drop initially is 3 mm and after one hour it is found to be 2 mm. If $r(t)$ represents the radius of the drop at time 't' then :

(A) $r(t) = 3 - t$ (B) $r(t) = 3 + t^3 - 2t$

(C) $r(t) = 3 + t^2 - 2t$ (D) $r(t) = 3 - t^3$

Q.14 Circle with centres O, O' and P each tangent of the line L and also mutually tangent. If the radii of circle O and circle O' are equal and the radius of the circle P is 6, then the radius of the larger circle is :



(A) 22 (B) 23
(C) 24 (D) 25

Q.15 If the tangent to the ellipse $x^2 + 4y^2 = 16$ at a point $(4\cos\theta, 2\sin\theta)$ passes through the focus of the parabola $x^2 = 8(y - 6)$, then :

(A) $\sin\theta = \frac{1}{4}$ (B) $\sin\theta = \frac{2}{3}$
(C) $\tan\theta = \frac{1}{4}$ (D) $\cot\theta = \frac{1}{3}$

Q.16 The number of subsets of set {1, 2, 3, ... 10} having at least one odd and at least one even integer :

(A) 6400 (B) 960
(C) 961 (D) None of these

Q.17 If $\int_0^{x^2} f(t)dt = 3x^2 + \int_{x^2}^{1} tf(t)dt$, then $f(4) =$

(A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{3}{5}$ (D) $\frac{5}{7}$

Q.18 'A' is one of 6 horses entered for a race, and is to be ridden by one of two Jockeys B and C. It is 2 to 1 that B rides A, in which case all the horses are equally likely to win. If C rides A, its chance of winning is tripled. The odds against horse A winning is :

(A) 12 : 7 (B) 13 : 5
(C) 7 : 12 (D) None of these

Q.19 If $f(x) = x^2 - 3x + 1$; $x \geq 2$ and $g(x)$ is inverse function of $f(x)$, then find the value of $g'(1)$:

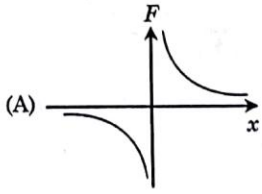
(A) 1/2 (B) 1/3 (C) 1 (D) 3

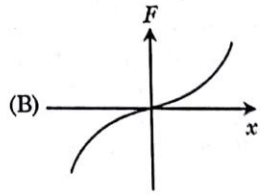
Q.20 $\lim_{n\to\infty} n(\sqrt[3]{n^3+3n^2+2n+1} + \sqrt{n^2-2n+3} - 2n) =$

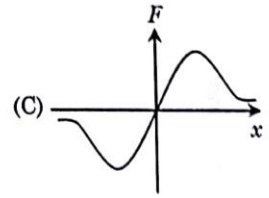
(A) 0 (B) 2/3 (C) 1/2 (D) 1

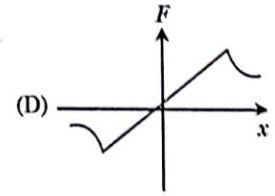
PHYSICS

Q.21 Which of the following graphs best represents the force acting on a charged particle kept at distance x from the centre of a square and on the axis of the square whose corners have equal charges.

(A)


(B)


(C)


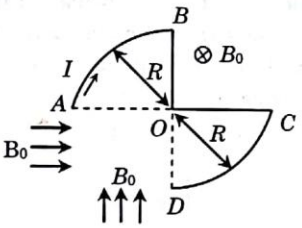
(D)


Q.22 A charged particle moves with a constant velocity $(\hat{i}+\hat{j})$ m/s in a magnetic field $\vec{B}=(2\hat{i}+3\hat{k})$ T and uniform electric field $\vec{E}=(a\hat{i}+b\hat{j}+c\hat{k})$ N/C, then (assuming all quantities in S.I. Unit

(A) $a=3$ (B) $b=-3$

(C) $c=-2$ (D) $a^2+b^2+c^2=22$

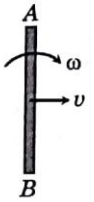
Q.23 Wire bent as $ABOCD$ as shown, carries current I entering at A and leaving at D. Three uniform magnetic fields each B_0 exist in the region as shown. The force on the wire is -



(A) $\sqrt{3}\,IRB_0$ (B) $\sqrt{5}\,IRB_0$

(C) $\sqrt{8}\,IRB_0$ (D) $\sqrt{6}\,IRB_0$

Q.24 A metal rod of length ℓ, moving with an angular velocity ω and velocity of its centre is v. Find potential difference between points A and B at the instant shown in figure. A uniform magnetic field of strength B exist perpendicular to plane of paper



(A) $Bv\ell$

(B) $Bv\ell+\frac{1}{2}B\omega\ell$

(C) $Bv\ell-\frac{1}{2}B\omega\ell^2$

(D) $Bv\ell+B\omega\left(\frac{\ell}{2}\right)^2$

Q.25 An uncharged capacitor of capacitance C is connected with an ideal cell. The emf of the cell is slowly increased from 0 to V (by some mechanism), The total energy taken from the cell in the process of charging of the capacitor is (assume the resistance of the circuit is very small)

(A) $\frac{1}{2}CV^2$ (B) $2CV^2$

(C) $\frac{1}{4}CV^2$ (D) CV^2

Q.26 The capacitor show in figure 1 is charged completely by connecting switch S to contact a. If switch S is thrown to contact b at time $t=0$, Which of the curves in figure 2 above represents the magnitude of the current through the resistor R as function of time t ?

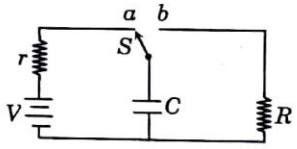
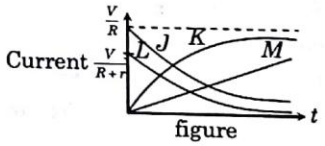


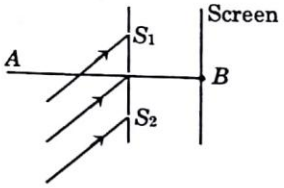
figure 1



figure

(A) J (B) K (C) L (D) M

Q.27 A beam of light parallel to central line AB is incident on the plane of slits in a $YDSE$ experiment as shown, The number of minima obtained on the large screen is n_1. Now if the beam is tilted by some angle ($\neq 90^\circ$) as shown in the figure, then the number of minima obtained is n_2. Then



(A) $n_1=n_2$ (B) $n_1>n_2$

(C) $n_2>n_1$ (D) None of these

Q.28 A charge particle q_0 of mass m_0 is projected along the y-axis at $t = 0$ from origin with a velocity V_0. If a uniform electric field E_0 also exists along the x-axis, then the time at which debroglie wavelength of the particle becomes half of the initial value is :

(A) $\frac{m_0 v_0}{q_0 E_0}$ (B) $2\frac{m_0 v_0}{q_0 E_0}$

(C) $\sqrt{3}\frac{m_0 v_0}{q_0 E_0}$ (D) $3\frac{m_0 v_0}{q_0 E_0}$

Q.29 In an x-ray tube, if the accelerating potential difference is changed, then

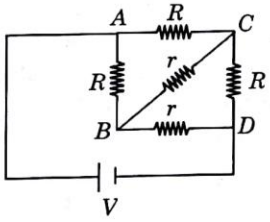
(A) the frequency of characteristic x-rays of a material will get changed

(B) Number of electrons emitted will change

(C) the difference between λ_0 (minimum wavelength) and λ_{ka} (wavelength of k_a x-ray) will get changed

(D) difference between λ_{ka} and λ_{kb} will get changed

Q.30 In the given circuit diagram, potential difference between A and C is $\frac{V}{4}$. Then current in branch BC is



(A) $\frac{V}{2R}$ (B) $\frac{V}{4r}$ (C) Zero (D) $\frac{3V}{4r}$

Q.31 A lens is placed between a source of light and a wall. it forms images of area A_1 and A_2 on the wall, for its two different positions. The area of the source of light is (source and wall are fixed)

(A) $(A_1A_2)^{1/2}$ (B) $\frac{A_1 + A_2}{2}$

(C) $\left(\frac{1}{A_1} + \frac{1}{A_2}\right)^{-1}$ (D) $\left(\frac{\sqrt{A_1} + \sqrt{A_2}}{2}\right)^2$

Q.32 The value of current in two series L C R circuits at resonance is same when connected across a sinusoidal voltage source. Then

(A) both circuits must be having same value of capacitance and inductor

(B) in both circuits ratio of L and C will be same

(C) for both the circuits X_L / Xc must be same at that frequency

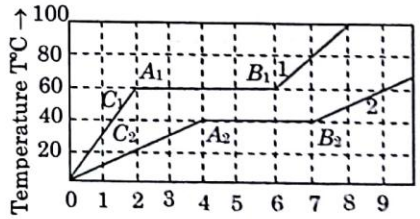
(D) both circuits must have same impedance at all frequencies

Q.33 The binding energies of the atom of elements A & B are E_a & E_b respectively. Three atoms of the element B fuse to give one atom of element A This fusion process is accompanied by release of energy e. Then E_a, E_b are related to each other as

(A) $E_a + e = 3E_b$ (B) $E_a = 3E_b$

(C) $E_a - e = 3E_b$ (D) $E_a + 3E_b + e = 0$

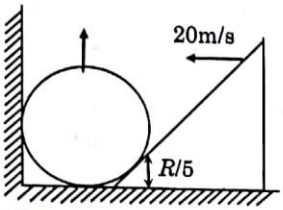
Q.34 Two solid bodies of equal mass m initially at $T = 0°C$ are heated at a uniform and same rate under identical conditions. The temperature of the first object with latent heat L_1 and specific heat capacity in solid state C_1 changes according to graph 1 on the diagram. The temperature of the second object with latent heat L_2 and specific heat capacity in solid state C_2 changes according to graph 2 on the diagram. Based on what is shown on the graph the latent heats L_1 and L_2 and the specific heat capacities C_1 and C_2 in solid state obey which of the following relationships



(A) $L_1 > L_2$; $C_1 < C_2$ (B) $L_1 < L_2$; $C_1 < C_2$

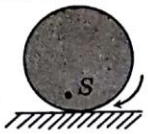
(C) $L_1 > L_2$; $C_1 > C_2$ (D) $L_1 < L_2$; $C_1 > C_2$

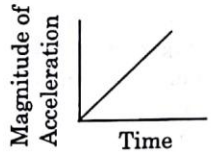
Q.35 A sphere of radius R is in contact with a wedge. The point of contact is $R/5$ from the ground as shown in the figure. Wedge is moving with velocity 20m/s, then the velocity of the sphere at this instant will be:

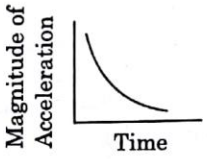


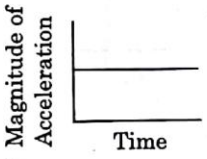
(A) 20m/s (B) 15 m/s
(C) 5 m/s (D) 10 m/s

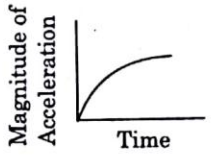
Q.36 As shown in figure, S is a uniform disc rolling with uniform angular velocity on a fixed rough horizontal surface. The only forces acting on the disc are its weight and contact forces exerted by horizontal surface. Which graph best represents the magnitude of the acceleration of point S as a function of time



(A) 

(B) 

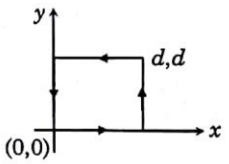
(C) 

(D) 

Q.37 When a ball released from rest in a very long column of viscous liquid, its downward acceleration is 'a' (just after release). Then its acceleration when it has acquired two third of the maximum velocity

(A) $a/3$ (B) $2a/3$
(C) $a/6$ (D) None of these

Q.38 The work done by the force $\vec{F} = A(y^2\hat{i} + 2x^2\hat{j})$, where A is a constant and x & y are in meters around the path shown is



(A) Zero (B) Ad
(C) Ad^2 (D) Ad^3

Q.39 Two strings X and Y of a sitar produces a beat of frequency 4Hz. When the tension of string Y is slightly, increased, beat frequency is found to be 2Hz. If the frequency of X is 300sHz, then the original frequency of Y was

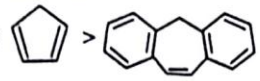
(A) 296 Hz
(B) 198 Hz
(C) 302 Hz
(D) 304 Hz

Q.40 Thermal coefficient of volume expansion at constant pressure for an ideal gas sample of n moles having pressure P_0, Volume V_0 and temperature T_0 is

(A) $\frac{R}{P_0V_0}$ (B) $\frac{P_0V_0}{R}$
(C) $\frac{1}{T_0}$ (D) $\frac{1}{nT_0}$

CHEMISTRY

Q.41 The incorrect acidic strength order of the following is ?

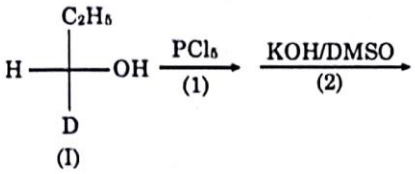
(A)  >

(B) $CH(NO_2)_3 > CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

(C) $CH_3-OH > CH_3-SH$

(D) $CH_3-COOH > CH_3-CO_3H$

Q.42 The relationship between the reactant (I) and the product (II) is :



(I)

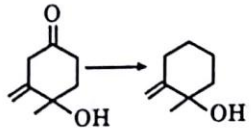
(A) Position isomers

(B) Identical compounds

(C) Enantiomers

(D) Diastereomers

Q.43 This reduction is best accomplished by –



This reduction is best accomplished by -

(A) Zn-Hg/conc. HCl

(B) N_2H_4/C_2H_5ONa

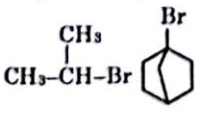
(C) Pd/H_2

(D) All of the above

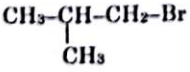
Q.44 How many of the following substrates can give S_N1 reaction ?

CH_3-Br CH_3-CH_2-Cl $OHC-CH_2-Br$

$CH_2=CH-CH_2-Br$



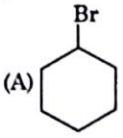
$CH_2=CH-Br$

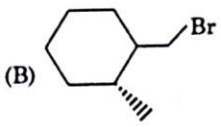


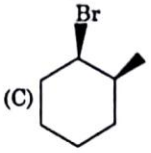
is -

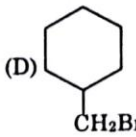
(A) 3 (B) 4 (C) 2 (D) 5

Q.45 Which of the compound give same product by SN_1 and SN_2 (excluding stereoisomer) -

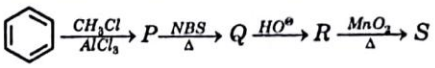
(A) 

(B) 

(C) 

(D) 

Q.46 The end product of following reaction is :



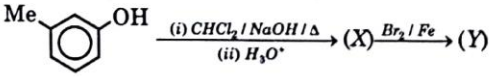
(A) Benzyl alcohol

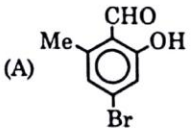
(B) Benzene carbaldehyde

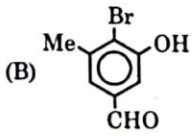
(C) Benzoic acid

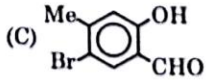
(D) Benzophenone

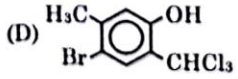
Q.47 The product (Y) of the following sequence of reactions would be -



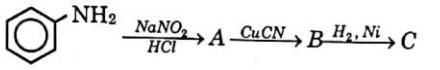
(A) 

(B) 

(C) 

(D) 

Q.48 Aniline in a set of reaction yield a product *D*. The structure of product *C* would be -



(A) $C_6H_5CH_2NH_2$ (B) $C_6H_5NHCH_2CH_3$
(C) C_6H_5NHOH (D) $C_6H_5CH_2OH$

Q.49 Froth floatation process for the concentration of sulphide ores is an illustration of the practical application of -
(A) adsorption (B) absorption
(C) sedimentation (D) coagulation

Q.50 The rate of a first order reaction is 3×10^{-4} mole litre^{-1} s^{-1} at 25 minutes and 2×10^{-4} mol litre^{-1} s^{-1} at 75 minutes after initiation. Find the half life of the reaction. (log 3 = 0.48, log 2 = 0.3)
(A) $\frac{250}{3}$ min (B) $\frac{200}{3}$ min
(C) 60 min (D) none of these

Q.51 When conc. HNO_3 is treated with P_4O_{10} it forms -
(A) N_2O (B) NO (C) NO_2 (D) N_2O_5

Q.52 Adsorption of gases on solid surface is generally exothermic because -
(A) enthalpy is positive
(B) entropy decreases
(C) entropy increases
(D) free energy increases

Q.53 25 ml solution consist of $C_2O_4^{2-}$ ion in it. It is found to require 10 ml of $\frac{N}{10}$ acidic $K_2Cr_2O_7$ for complete reaction. Find out molarity of $C_2O_4^{2-}$ solution.
(A) $\frac{1}{25}$ (B) $\frac{1}{10}$ (C) $\frac{1}{20}$ (D) $\frac{1}{50}$

Q.54 Henry law constant of N_2 at 293 K is 76.48 k bar. If N_2 is bubbled through water at 293 K at pressure of 1 atm. How many millimoles of it will dissolve in 10 L of water ?
(A) 17.16 m mol (B) 7.16 m mol
(C) 15.2 m mol (D) 10.2 m mol

Q.55 Which is the correct sequence in the following properties. For the correct order mark (T) and for the incorrect order mark (F) :
(a) Acidity order :
$SiF_4 < SiCl_4 < SiBr_4 < SiI_4$
(b) Melting point :
$NH_3 > SbH_3 > AsH_3 > PH_3$
(c) Boiling point :
$NH_3 > SbH_3 > SbH_3 > AsH_3 > PH_3$
(d) Dipole moment order :
$NH_3 > SbH_3 > AsH_3 > PH_3$
(A) FTFT (B) TFTF (C) FFTT (D) FFTF

Q.56 Which of the following metals is obtained by the self reduction process ?
(A) Copper (B) Iron
(C) Silver (D) Magnesium

Q.57 Colourless salt (a) + dil. H_2SO_4 or CH_3COOH + KI → blue colour with starch. (a) can be -
(A) K_2SO_3 (B) Na_2CO_3
(C) NH_4NO_2 (D) NH_4Cl

Q.58 Which of the following statement is incorrect about the f-block elements ?
(A) f-block consists of two series, lanthanoids and actinoids.
(B) Lanthanoids show in general stable common oxidation state, +3.
(C) The actinoids are radioactive elements.
(D) Actinoids contraction is smaller from element to element than lanthanoids contraction

Q.59 Which of the following complexes has the highest stability constant at 298 K ?

(A) $[CdCl_4]^{2-}$ (B) $[CdBr_4]^{2-}$

(C) $[CdI_4]^{2-}$ (D) $[Cd(CN)_4]^{2-}$

Q.60 Which is true for ideal solution -

(A) $\Delta S_{mix.} = -Ve$ (B) $\Delta H_{mix.} = +ve$

(C) $\Delta G_{mix.} = -Ve$ (D) $\Delta V_{mix.} = -Ve$

BIOLOGY

Q.61 During seed germination its stored food is mobilized by

(A) Cytokinin (B) ABA

(C) Gibberellin (D) Ethylene

Q.62 Interfascicular cambium develops from the cells of

(A) Xylem parenchyma

(B) Endodermis

(C) Pericycle

(D) Medullary rays

Q.63 For its activity, cytochrome oxidase requires

(A) Zinc (B) Iron

(C) Copper (D) Selenium

Q.64 Organelle which is able to synthesise proteins from its own genetic material within a cell :

(A) Ribosomes (B) Mitochondria

(C) Lysosomes (D) ER

Q.65 Flowering is regulated by low temperature and day length in many plants. These two aspect are related with

(A) Apical dominance, cold treatment

(B) Chilling effect, light compensation point

(C) Vernalization & photoperiodism

(D) Antigibberellin Gibberellin

Q.66 The distance between two base pairs of a DNA double helix is

(A) 34 Å (B) 34 nm

(C) 3.4 Å (D) 3.4 μm

Q.67 Glycolysis is

(A) biosynthesis of glucose

(B) biosynthesis of glycine

(C) degradation of glucose

(D) reaction of glucose with proteins

Q.68 Age of a tree can be estimated by

(A) biomass

(B) number of annual rings

(C) diameter of its heartwood

(D) its height and girth

Q.69 Path-finding by ants is by means of

(A) Visually observing landmarks

(B) Visually observing other ants

(C) Chemical signals between ants

(D) Using the earth's magnetic field

Q.70 Fruits are often shipped in containers to prevent overripening of fruits which of the following is used in container for it

(A) Ethylene (B) High oxygen

(C) High N_2 (D) High CO_2

Q.71 Match the following list bioactive substances and their roles

Bioactive	Substance Role
(i) Statin	(a) Removal of oil Stains
(ii) Cyclosporin A	(b) Removal of clots from blood vessels
(iii) Streptokinase	(c) Lowering of blood cholesterol
(iv) Lipase	(d) Immuno suppressive agent

(A) i - b, ii - c, iii - a, iv – d

(B) i - d, ii - b, iii - a, iv – c

(C) i - d, ii - a, iii - d, iv – c

(D) i - c, ii - d, iii - b, iv – a

Q.72 Choose incorrect statement

(A) Microbes like bacteria & many fungi cultures are usefuls in studies on micro-organism

(B) During growth, the LAB produce acids that coagulate and partially digest the milk proteins

(C) Roquefort cheese are ripened by growing a specific fungi on them, which gives them a particular flavour

(D) Wine & beer are produced by distillation of fermented broth

Q.73 Choose incorrect statement

(A) The big bang theory attempts to explain to us origin of universe

(B) The UV rays from the sun broken up water into hydrogen, oxygen and the lighter H_2 excaped

(C) Miller created electric discharge in a closed flask containing CH_4, H_2, NH_3 & water vapour at 400°C

(D) The fitness, according to darwin, refers ultimately and only to reproduce fitness

Q.74 Choose correct Statement

(a) Five factors affect hardy-weinbury equilibrium are as gene migration or gene flow, genetic drift, mutation genetic recombination & natural selection

(b) Some of land reptiles went back into water to evolve into fish, like reptiles probably 200 my a (e.g ichthyosaurs)

(c) First organism that invaded land were plants

(d) lobefins first ambhibans that lived on both land and water

(A) a, b, c (B) b, c, d

(C) a, b, c, d (D) a, d

Q.75 Many diseases can be diagnosed by observing the symptoms in the patient. Which group of symptoms are indicative of pneumonia ?

(A) Difficulty in respiration, fever, chills, cough, headache

(B) Constipation, abdominal pain, cramps, blood clots

(C) Nasal congestion and discharge, cough, sorethroat, headache

(D) High fever, weakness, stomach pain, loss of appetite and constipation

Q.76 Smack' is a drug obtained from the

(A) Latex of Papaver somniferum

(B) Leaves of Cannabis sativa

(C) Flowers of Dhatura

(D) Fruits of Erythroxyl coca

Q.77 Which of the following is false related to ultrasonography

(A) It uses ultrasound wave energy for production of images of body's internal organs

(B) Echocardiography is sonography of heart

(C) It is the transparency of piezo electric material which is a critical factor in allowing proper vibrational frequency

(D) It is the commonly used medical procedure to monitor status of foetus during pregnancy.

Q.78 Correct combination from column, I, II and III is –

Column I	Column II	Column III
(i) Rheumatoid Arthritis	(A) Yellowish fluid secreted by mother	(P) Auto Immune disease
(ii) Colostrum	(B) Body attacks self cells	(Q) Example of Active Immunity
(iii) Cell mediated Immunity	(C) Mediated by B-Lymphocytes	(R) Responsible for graft rejection

(A) (i), (C)(Q) (B) (i), (B)(P)

(C) (ii), (A)(Q) (D) (iii), (C)(R)

Q.79 How many sperms and ova will be produced from 25 primary spermatocytes and 25 primary oocytes respectively

(A) 100 sperms and 100 ova

(B) 100 sperms and 50 ova

(C) 100 sperms and 25 ova

(D) 50 sperms and 25 ova

Q.80 Layers of an ovum from outside to inside is

(A) corona radiata, zone pellucida, vitelline membrane

(B) zone pellucida, corona radiata, vitelline membrane

(C) vitelline membrane, zone pellucida, corona radiata

(D) zone pellucida, vitelline membrane, corona radiata

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 Let $f(x)$ = Min. $\{x-2, \sqrt{4-x}\}$ then area bounded by $y = f(x)$ and x-axis is

(A) $\frac{7}{6}$ sq. units (B) $\frac{11}{3}$ sq. units

(C) $\frac{19}{3}$ sq. units (D) 14 sq. units

Q.82 Let f & g be two functions defined as follows :

$f(x) = \frac{x+|x|}{2}$ for all x &

$g(x) = \begin{cases} x & \text{for } x < 0 \\ x^2 & \text{for } x \geq 0 \end{cases}$ then :

(A) (gof) (x) & (fog) (x) are both cont. for all $x \in R$

(B) (gof) (x) & (fog) (x) are unequal functions

(C) (gof) is non-differentiable at $x = 0$

(D) (fog) (x) is not differentiable at $x = 0$

Q.83 $f : P \to Q$ defined by $f(x) = 4x - x^2$ is a bijective function if

(A) $P = [3, \infty)$, $Q \in (-\infty, 4]$

(B) $P = [2, \infty)$, $Q \in [4, \infty)$

(C) $P = (-\infty, 2]$, $Q \in [4, \infty)$

(D) $P = (-\infty, 2]$, $Q \in (-\infty, 4]$

Q.84 $\int \frac{x^4+4}{x^2-2x+2}\,dx$ is

(A) $\frac{x^3}{2}+x^2+2x+c$ (B) $\frac{x^3}{3}+x^2+2x+c$

(C) $\frac{x^3}{3}+\frac{x^2}{2}+x+c$ (D) $\frac{x^3}{3}+x^2-2x+c$

Q.85 The minimum value of $\left(1+\frac{1}{\sin^n \alpha}\right)\left(1+\frac{1}{\cos^n \alpha}\right)$ is :

(A) 1

(B) 2

(C) $(1 + 2^{n/2})^2$

(D) None of these

Q.86 Equation of mirror image of parabola $y^2 = 4x$ in the line $x - y + 2 = 0$ is :

(A) $4(y-2) = (x-2)^2$

(B) $4(y+2) = (x+2)^2$

(C) $4(y-2) = (x+2)^2$

(D) $(y-2) = (x+2)^2$

Q.87 A man wants to buy m mangoes in n different varieties, (where $n > m$) mangoes of the same variety being identical and they are available in abundance. Number of different ways he can plan his purchases, if he has to buy atleast two mangoes of the same variety is :

(A) ${}^{m-2n}C_{n-1}$

(B) ${}^{m+n-3}C_{m-1}$

(C) $\frac{1}{m!}\left[{}^{m+n-1}P_m - {}^{n}P_m\right]$

(D) $\frac{1}{m!}\left[{}^{m+n-1}P_{n-1} - {}^{n}P_m\right]$

Q.88 The co-efficient of x^{n-2} in the polynomial $(x-1)(x-2)(x-3)\ldots\ldots\ldots(x-n)$ is :

(A) $\frac{n(n^2+2)(3n+1)}{24}$

(B) $\frac{n(n^2-1)(3n+2)}{24}$

(C) $\frac{n(n^2+1)(3n+4)}{24}$

(D) None of these

Q.89 Tangent at (0, 0), to the curve $y^2 = x^3 + x^2$

(A) touches X-axis

(B) bisects the angle between the axes

(C) makes an angle of 60° with OX

(D) None of these

Q.90 The complete solution set of $|\cos 3x| + |\cos x| = |\cos 3x + \cos x|$ belonging to $[0, \pi]$ is

(A) $\left\{\frac{\pi}{2}\right\} \cup \left[\frac{\pi}{6}, \frac{5\pi}{6}\right]$

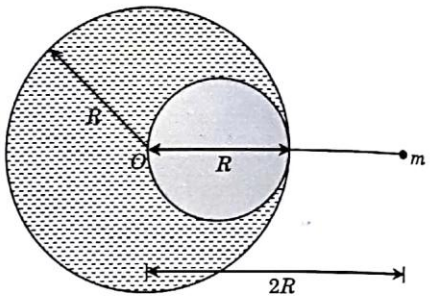
(B) $\left\{\frac{\pi}{2}\right\} \cup \left[0, \frac{\pi}{6}\right]$

(C) $[0, \pi]$

(D) $\left\{\frac{\pi}{2}\right\} \cup \left[0, \frac{\pi}{6}\right] \cup \left[\frac{5\pi}{6}, \pi\right]$

PHYSICS

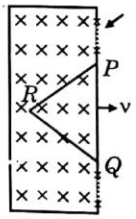
Q.91 A uniform sphere of mass M and radius R exerts a force F on a small mass m situated at a distance of $2R$ from the centre O of the sphere. A spherical portion of diameter R is cut from the sphere as shown. The force of attraction between the remaining part of the sphere and the mass m will be -

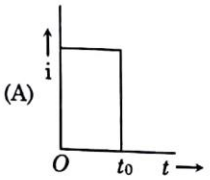


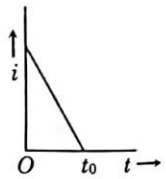
(A) $\frac{7F}{9}$ (B) $\frac{2F}{3}$

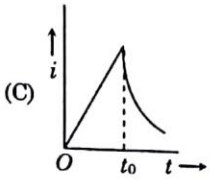
(C) $\frac{4F}{9}$ (D) $\frac{F}{3}$

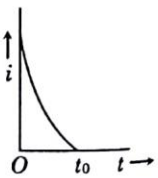
Q.92 An equivalent triangular loop PQR of side a is at the edge of a uniform magnetic field B at $t = 0$ as shown. It is pulled to the right with a constant velocity v and its edge R leaves the region of magnetic field at $t = t_0$. Which of the graphs shown represents the variation of induced current i with time t.



(A) 

(B) 

(C) 

(D) 

Q.93 The principal section of a glass prism is an isosceles triangle ABC with AB = AC. The face AC is silvered. A ray incident normally on face AB, after two reflections, emerges from the base BC in a direction perpendicular to it. What is the $\angle BAC$ of the prism -

(A) 30° (B) 36°

(C) 60° (D) 72°

Q.94 When a trapeze artist, spinning in air, folds his body, his moment of inertia decreases from I_1 to I_2. The work done by him in this process is proportional to -

(A) $I_1 - I_2$ (B) $1/I_2 - 1/I_1$

(C) $1/(I_1 - I_2)$ (D) $I_1I_2/(I_1-I_2)$

Q.95 A long glass capillary tube is dipped in water. It is known that water wets glass. The water level rises by h in the tube. The tube is now pushed down so that only a length $h/2$ is outside the water surface. The angle of contact of the water surface at the upper end and the tube will be -

(A) 30° (B) 45°

(C) $\tan^{-1} 2$ (D) 60°

Q.96 When an athlete runs with some acceleration, he leans forward. The line joining his centre of mass to his foot which is in contact with the ground makes an angle θ with the vertical. The coefficient of friction between his foot and the ground is k. His foot does not slip on the ground. His acceleration is -

(A) kg (B) kg tan θ

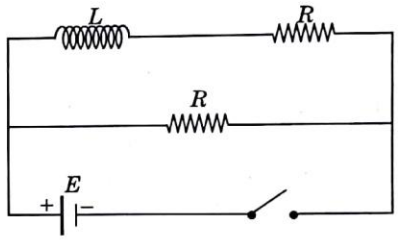
(C) g tan θ (D) (g tan θ) k

Q.97 A capacitor of capacitance C is charged to a potential difference V from a cell and then disconnected from it. A charge + Q is now given to its positive plate. The potential difference across the capacitor is now -

(A) V (B) $V + \frac{Q}{C}$

(C) $V + \frac{Q}{2C}$ (D) $V - \frac{Q}{C}$, if $V < CV$

Q.98 A coil of self-inductance L and resistance R is connected to a resistance R and a cell of emf E, as shown. The switch is kept closed for a long time and then opened. The heat produced in each of the resistors, after opening the switch, is -



(A) $LE^2 / 2R^2$ (B) $LE^2 / 4R^2$

(C) $LE^2/8R^2$ (D) $2LE^2 / 3R^2$

Q.99 A solid sphere of radius R rests on a smooth horizontal surface. It receives a horizontal impulse at a height h above the surface, if the sphere to begin rolling without slipping at once, h must be equal to -

(A) $\frac{5R}{3}$ (B) $\frac{5R}{4}$ (C) $\frac{7R}{5}$ (D) $\frac{3R}{2}$

Q.100 Two particles of masses m_1 and m_2 in projectile motion have velocities $\vec{v}_1$ and $\vec{v}_2$, respectively, at time $t = 0$. They collide at $t = t_0$. Their velocities become $\vec{v}_1'$ and $\vec{v}_2'$ at $t = 2t_0$ while still moving in air. The value of

$|(m_1\vec{v}_1' + m_2\vec{v}_2') - (m_1\vec{v}_1 + m_2\vec{v}_2)|$ is-

(A) zero (B) $(m_1 + m_2)gt_0$

(C) $2(m_1 + m_2)gt_0$ (D) $\frac{1}{2}(m_1 + m_2)gt_0$

CHEMISTRY

Q.101 Two liquids '*A*' and '*B*' are mixed in the molar ratio of 1 : 2 and the vapour pressure of the solution is 24 torr. When the two liquids are mixed in the reverse ratio, the vapour pressure of the solution increases by a fraction of $\frac{1}{4}$. The vapour pressure of pure '*A*' and '*B*' are respectively.

(A) 20 torr, 40 torr

(B) 40 torr, 20 torr

(C) 36 torr, 18 torr

(D) 18 torr, 36 torr

Q.102 Which of the following is correct about B_2H_6

(A) Each '*B*' atom is sp^3 hybridised

(B) It consists of two-"3 centre 3 electron bonds"

(C) The two bridging *H*-atoms are in the plane of the molecules

(D) All the above are correct

Q.103 Three moles of an ideal gas [C_p = 7/2 R] at pressure '*P*' and temperature '*T*' is isothermally expanded to twice its initial volume. It is then compressed at constant pressure to its original volume. Finally the gas is brought at constant volume to its original pressure *P*.

Consider the following diagrams. P-V and P-T diagrams for the processes.

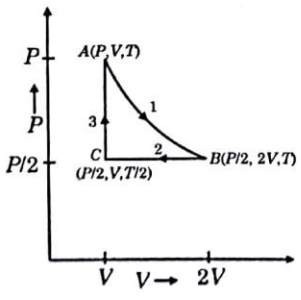


Diagram-1 (*P-V*)

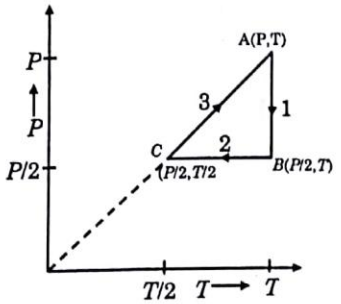


Diagram-2 (*P-T*)

(A) On diagram-1 is correct

(B) Only diagram-2 is correct

(C) Both diagram are correct

(D) No diagram is correct

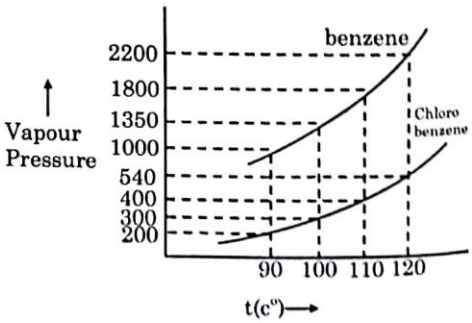
Q.104 An acid-base indicator which is a weak acid has a pK_a value = 5.45. At what concentration ratio of sodium acetate to acetic acid would the indicator show a colour half-way between those of its acid and conjugate base forms ?

pK_a acetic acid = 4.75, [log 2 = 0.3]

(A) 4 : 1 (B) 7 : 1

(C) 5 : 1 (D) 2 : 1

Q.105 Assuming the formation of an ideal solution, determine the boiling point of a mixture containing 1560 g benzene (molar mass = 78) and 1125 g chlorobenzene (molar mass = 112.5) using the following against an external pressure of 1000 torr.



(A) 90°C (B) 100°C

(C) 110° (D) 120°C

Q.106 A student finds a crystal of NaCl having mass 58.5 mg. He uses some of it to prepare 0.05 M, 10 mL NaCl solution. How many unit cells are remaining in the crystal ?
($N_A = 6 \times 10^{23}$)
(A) 1.5×10^{20} (B) 7.5×10^{19}
(C) 3.5×10^{20} (D) None of these

Q.107 The product Z in the following reactions sequence is

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[(ii)\,H_2O]{(i)\,CH_3MgBr} (X) \xrightarrow[\text{Ether}]{\text{Na metal}} (Y) \xrightarrow{CH_3-Br} (Z)$$

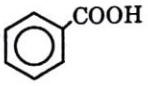
(A) $CH_3-\overset{CH_3}{\overset{|}{C}}=CH_2$

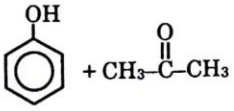
(B) $CH_3-\underset{CH_3}{\overset{|}{CH}}-O-CH_3$

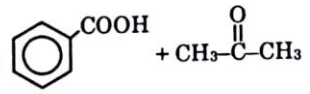
(C) $CH_3-\underset{CH_3}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}}-OCH_3$

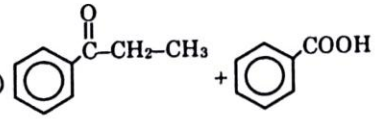
(D) $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

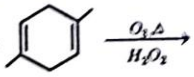
Q.108 After the zinc distillation of Phenol it reacts with propene in acidic medium and then on air oxidation followed by acid hydrolysis the final product is/are -

(A) 

(B) 

(C) 

(D) 

Q.109 The major product of the following reactions will be 

(A) $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-COOH$

(B) $CH_3-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-CH_3$

(C) $CH_3-\underset{O}{\overset{O}{\overset{\|}{\underset{\|}{C}}}}-CH_3$

(D) $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH=O$

Q.110 Match the classes of drugs given in Column 1 with their action given in Column II.

Column I	Column II
(1) Analgesics	(a) Treatment of Stress
(2) Antiseptics	(b) Pain killing effect
(3) Antacids	(c) Applied to diseased skin surfaces
(4) Tranquilisers	(d) Treatment of Acidity

(A) 1-a, 2-c, 3-d, 4-b (B) 1-b, 2-c, 3-d, 4-a
(C) 1-a, 2-b, 3-c, 4-d (D) 1-b, 2-c, 3-a, 4-d

BIOLOGY

Q.111 AIDS spreads due to all except -
(A) Homosexuality
(B) Infected syringes needle
(C) Blood transfusion
(D) By sneezing, spitting, coughing

Q.112 Choose correct statement -
(A) Rabies is a viral disease
(B) Polio is not a viral disease
(C) Malaria is a viral disease
(D) Cholera is a viral disease

Q.113 Choose correct statement -
(A) Malaria is a non-communicable disease
(B) Malaria is spread by culis mosquito
(C) Malaria is caused by plasmodium
(D) Antibiotics is useful in treatment of malaria

Q.114 All are true about cell theory about except -
(A) All plant/animal are of cells
(B) Cells are basic unit
(C) Cells are made up of nucleus cytoplasm
(D) Cells arise from pre-existing cells

Q.115 If glucose fed yeast cells are transferred from aerobic environment to anaerobic are the rate of glucose consumption will -
(A) decrease
(B) increase
(C) not change
(D) depends on condition

Q.116 A colour blind girl is rare because she will be born only when -
(A) her mother and maternal grand father were colour blind
(B) her father and maternal grand father were colour blind
(C) her mother is colour blind and father has normal vision
(D) parents have normal vision but grand parents were colour blind

Q.117 A child's blood group is 'O'. The parent's blood groups cannot be -
(A) A and B (B) A and A
(C) AB and O (D) B and O

Q.118 The genes, which remain confined to differential region of Y-chromosome, are -
(A) autosomal genes
(B) holandric genes
(C) completely sex-linked genes
(D) mutant genes

Q.119 An abnormal human male phenotype involving an extra X-chromosomes (XXY) is a case of -
(A) Edward's syndrome
(B) Klinefelter's syndrome
(C) Intersex
(D) Down's syndrome

Q.120 A genetically diseased father (male) marries with a normal female and gives birth to 3 carrier girls and 5 normal sons. It may be which type of genetic diseases ?
(A) sex-influenced disease
(B) blood group inheritance disease
(C) sex-linked disease
(D) sex-recessive disease

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-10

Time : 3 Hrs **Max. Marks : 160**

GENERAL INSTRUCTIONS :

- The test booklet consists of 120 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 20 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 21 to 40 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 41 to 60 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 61 to 80 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 81 to 90 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 91 to 100 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 101 to 110 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 111 to 120 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 Line L_1 is parallel to vector $\vec{\alpha} = -3\hat{i} + 2\hat{j} + 4\hat{k}$ and passes through a point A (7, 6, 2) and line L_2 is parallel to a vector $\vec{\beta} = 2\hat{i} + \hat{j} + 3\hat{k}$ and passes through a point B(5, 3, 4). Now a line L_3 parallel to a vector $\vec{r} = 2\hat{i} - 2\hat{j} - \hat{k}$ intersects the lines L_1 and L_2 at points C and D respectively, then $|\overrightarrow{CD}|$ is equal to -

(A) 7 (B) 8

(C) 9 (D) None of these

Q.2 If $x = -5 + 4i$, then $x^4 + 9x^3 + 35x^2 - x + 4 =$

(A) –164 (B) 164

(C) –160 (D) 160

Q.3 The value of $\sum_{r=1}^{n}(-1)^{r-1}\left(1+\frac{1}{2}+\frac{1}{3}+...+\frac{1}{r}\right){}^nC_r$ is equal to -

(A) –1 (B) $\frac{1}{r}$

(C) $\frac{1}{n}$ (D) $-\frac{1}{n}3$

Q.4 The range of values of 'a' such that the angle θ between the pair of tangents drawn from the point $(a, 0)$ to the circle $x^2 + y^2 = 1$ satisfies $\frac{\pi}{2} < \theta < \pi$ is -

(A) $(1, 2)$

(B) $(1, \sqrt{2})$

(C) $(-\sqrt{2}, -1)$

(D) $(-\sqrt{2}, -1) \cup (1, \sqrt{2})$

Q.5 Number of solution of the equation

$$z^3 + \frac{3(\bar{z})^2}{|z|} = 0$$

where z is a complex number is -

(A) 2 (B) 3

(C) 6 (D) 5

Q.6 Let $f(x) = \min(\{x\}, \{-x\})\ \forall\ x \in R$ (where $\{\cdot\}$ represents fractional part function) then $\int_{-100}^{100} f(x)dx$

(A) 50 (B) 100

(C) 200 (D) None of these

Q.7 If $P = \begin{vmatrix} 1+a & 1+ax & 1+ax^2 \\ 1+b & 1+bx & 1+bx^2 \\ 1+c & 1+cx & 1+cx^2 \end{vmatrix}$ then -

(A) P is independent of x

(B) $P = (x-a)(x-b)(x-c)$

(C) $P = abc\, x^3$

(D) None these

Q.8 Solution of the differential equation $y' + y\sec^2 x = \sec^2 x \tan x$ is -

(A) $y = \tan x + 1 + ce^{-\tan x}$

(B) $y = \tan x - 1 + ce^{-\tan x}$

(C) $y = \tan x - 1 + ce^{\tan x}$

(D) None of these

Q.9 The area of rhombus formed by foci of hyperbola $9x^2 - 16y^2 = 144$ and its conjugate hyperbola is -

(A) $\frac{75}{8}$ (B) 50

(C) $\frac{75}{2}$ (D) $\frac{75}{4}$

Q.10 Find the number of solutions of the equation, $\tan(\cos^{-1} x) = \sin\left(\cot^{-1}\frac{1}{2}\right)$ is -

(A) 1 (B) 2

(C) 3 (D) No solution

Q.11 Evaluate $\lim_{x\to 0} \frac{x}{a}\left[\frac{b}{x}\right]$, (where $[\cdot]$ denotes the greatest integer function).

(A) $\frac{b}{a}$ (B) 0

(C) $\frac{a}{b}$ (D) does not exist

Q.12 Let A be a matrix of order 3 and let Δ denotes the value of determinant A. Then $\det(-2A) =$

(A) -8Δ (B) -2Δ

(C) 2Δ (D) 8Δ

Q.13 If $y = \frac{1}{2x^2 + 3x + 1}$ then $\frac{d^2y}{dx^2}$ at $x = -2$ is -

(A) $\frac{38}{27}$ (B) $-\frac{38}{27}$

(C) $\frac{27}{38}$ (D) None of these

Q.14 The image of the interval $[-1, 3]$ under the mapping specified by the function $f(x) = 4x^3 - 12x$ is -

(A) $[f(+1), f(-1)]$ (B) $[f(-1), f(3)]$

(C) $[-8, 16]$ (D) $[-8, 72]$

Q.15 Two dice are rolled to get the coordinates of a point $P(x, y)$ in the Cartesian plane. Find the probability that area of ? ΔPAB is 1 sq. unit, where $A \equiv (1, 1)$, $B \equiv (2, 0)$.Given that P, A, B lie in anticlockwise order in the plane -

(A) $\frac{1}{6}$ (B) $\frac{1}{36}$ (C) $\frac{1}{12}$ (D) $\frac{1}{2}$

Q.16 If p, q are two numbers such that $3 < p < 4$, $q > 4$ or $q < 3$ then $p^2(7q - 12)$ is -

(A) less than $q^2(7p - 12)$

(B) greater than $q^2(7p - 12)$

(C) less than $q^2(12p - 7)$

(D) greater than $q^2(12p - 7)$

Q.17 If A is the area and $2s$ the sum of the 3 sides of a triangle, then -

(A) $A \le \frac{s^2}{3\sqrt{3}}$ (B) $A = \frac{s^2}{2}$

(C) $A > \frac{s^2}{\sqrt{3}}$ (D) None of these

Q.18 If the straight line $x + 2y = 9$, $3x - 5y = 5$ & $ax + by = 1$ are concurrent, then the straight line $5x + 2y = 1$ passes through the point -

(A) $(a, -b)$ (B) $(-a, b)$

(C) (a, b) (D) $(-a, -b)$

Q.19 If $\cos^6\alpha + \sin^6\alpha + k\sin^2 2\alpha = 1$ $(0 < \alpha < \pi/2)$, then k is -

(A) 3/4 (B) 1/4

(C) 1/3 (D) 1/8

Q.20 The vector $\vec{c}$ is perpendicular to the vectors $\vec{a} = (2, -3, 1)$ $\vec{b} = (1, -2, 3)$ and satisfies the condition $\vec{c} \cdot (\hat{i} + 2\hat{j} - 7\hat{k}) = 10$. Then the vector $\vec{c}$ =

(A) (7, 5, 1)

(B) (–7. –5, –1)

(C) (1, 1, –1)

(D) None of these

PHYSICS

Q.21 The pressure P is related to distance x, Boltzmann constant k and temperature θ as :

$P = \frac{a}{b} e^{-ax/k\theta}$

The dimensional formula of b is :

(A) $[M^{-1}L^{-1}T^{-1}]$ (B) $[MLT^2]$

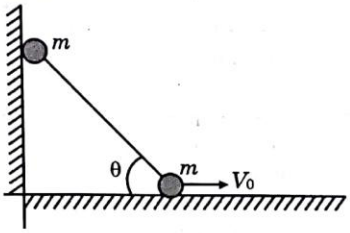
(C) $[M^0L^2T^0]$ (D) $[M^0L^0T^0]$

Q.22 It is possible to project a particle with a given velocity in two possible ways so as to make it pass through a point P at a distance r from the point of projection. The product of the times taken to reach this point in the two possible ways is then proportional to :

(A) $1/r$ (B) r

(C) r^3 (D) $1/r^2$

Q.23 In the shown figure two point masses m are joined by a massless rod of length 5.5 m. The lower end of the mass system is dragged with constant velocity v_0, rightwards. The kinetic energy of the system when $\theta = 53°$ is :



(A) $\frac{25}{12} mv_0^2$ (B) $\frac{25}{16} mv_0^2$

(C) $\frac{25}{32} mv_0^2$ (D) $\frac{25}{18} mv_0^2$

Q.24 Choose the correct statement. When the temperature of a gas is increased :

(A) the kinetic energy of its molecules increases

(B) the potential energy of its molecules increase

(C) the potential energy decreases and the kinetic energy increases; the total energy remaining unchanged

(D) the potential energy increases and the kinetic energy decreases; the total energy remaining unchanged

Q.25 The magnitude of the electric field in the annular region of a changed cylindrical capacitor :

(A) is the same throughout

(B) is higher near the outer cylinder than near the inner cylinder

(C) varies as $1/r$ where r is the distance from the axis

(D) varies as $1/r^2$ where r is the distance from the axis

Q.26 Which of the following statements is correct :

(A) Electrons drifting in a conductor under the influence of an electric field are accelerated by the field

(B) The drift speed of the electrons in a conductor is of order of a few mms^{-1}

(C) All free electrons in a metal move from a lower to higher potential

(D) Since the drift speed of electrons in metals is very small and he charge of an electron is extremely small, only a small amount of current can flow in metal

Q.27 When a magnetic material, originally unmagnetised, is subjected to a varying magnetic field H, the intensity of magnetization :

(A) increase linearly with H

(B) increases with H until it attains a maximum saturation value

(C) decreases with H until it attains a maximum negative value

(D) increase exponentially with H

Q.28 Which of the following cannot be accelerated in a cyclotron :

(A) Protons

(B) Deuterons

(C) Alpha particles

(D) Neutrons

Q.29 The magnifying power of a compound microscope is high if :

(A) both the objective and the eyepiece have short focal lengths

(B) both the objective and the eyepiece have long focal lengths

(C) the objective has a short focal length and the eyepiece has a long focal length

(D) the objective has a focal length and the eyepiece has a short focal length

Q.30 Choose the only correct statement. The speed of light in a given glass plate is :

(A) greater for violet than for red light

(B) greater for green than for yellow light

(C) less for blue than for green light

(D) the same for all colours of light

Q.31 Which one of the following statements in NOT true for de Broglie waves ?

(A) All atomic particles in motion have waves of a definite wavelength associated with them

(B) The higher the momentum, the longer is the wavelength

(C) The faster the particle, the shorter is the wavelength

(D) For the same velocity, a heavier particle has a shorter wavelength

Q.32 Cadmium rods are used in a nuclear reactor for :

(A) slowing down fast neutrons

(B) speeding up slow neutrons

(C) absorbing all the neutrons

(D) regulating the power level of the reactor

Q.33 The radioactive decay of an element X to elements Y and K is represented by the equation

$$^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y \rightarrow {}^{A-4}_{Z-1}K \rightarrow {}^{A-4}_{Z-1}K$$

The sequence of the emitted radiations is :

(A) α, β, γ (B) β, α, γ

(C) γ, α, β (D) β, γ, α

Q.34 The width of depletion region in a pn junction diodes :

(A) increases when a reverse bias is applied

(B) increases when a forward bias is applied

(C) decreases when a reverse bias is applied

(D) remains the same, irrespective of the bias voltage

Q.35 A large flat metal surface has a uniform charge density $+\sigma$. An electron of mass m and charge e leaves the surface at point A with speed u, and returns to it at point B. Disregard gravity. The maximum value of AB is :

(A) $\frac{u^2 m\varepsilon_0}{\sigma e}$ (B) $\frac{u^2 e\varepsilon_0}{m\sigma}$

(C) $\frac{u^2 e}{\varepsilon_0 \sigma m}$ (D) $\frac{u^2 \sigma e}{\varepsilon_0 m}$

Q.36 A small, flat coil of resistance r is placed at the centre of a large, closed coil of resistance R. The coils are coplanar. Their mutual inductance is M. Initially, a constant current i was flowing in the inner coil. If this current is suddenly switched off, what charge will circulate in the outer coil :

(A) Mir/R^2 (B) MiR/r^2

(C) Mi/R (D) Mi/r

Q.37 In a cell, or accumulator battery, current flows inside the cell from the negative plate to the positive plate when ?

(A) It drives current through an external source

(B) It is being charged from an external source

(C) Its emf is being measured by a potentiometer and the balance position has been reached

(D) When it is connected to a charged capacitor whose potential difference is greater than its emf, and its positive and negative plates are connected to the plates of similar polarities of the capacitor

Q.38 The velocity of sound in dry air is V_d, and in moist air it is V_m. The velocities are measured under the same conditions of temperature and pressure. Which of the following statements is fully correct ?

(A) $V_d > V_m$ because dry air has lower density than moist air

(B) $V_d < V_m$ because moist air has lower density than dry air.

(C) $V_d > V_m$ because the bulk modulus of dry air is greater than that of moist air.

(D) $V_d < V_m$ because the bulk modulus of moist air is greater than that of dry air.

Q.39 Two metal rods of the same length and area of cross-section are fixed end to end between rigid supports. The materials of the rods have Young modulli Y_1 and Y_2, and coefficients of linear expansion α_1 and α_2. The junction between the rods does not shift if the rods are cooled.

(A) $Y_1\alpha_1 = Y_2\alpha_2$ (B) $Y_1\alpha_2 = Y_2\alpha_1$

(C) $Y_1\alpha_1^2 = Y_2\alpha_2^2$ (D) $Y_1^2\alpha_1 = Y_2^2\alpha_2$

Q.40 When unit mass of water boils to become steam at 100°C, it absorbs Q amount of heat. The densities of water and steam at 100°C are ρ_1 and ρ_2 respectively, and the atmospheric pressure is p_0. The increase in the internal energy of the water is -

(A) Q (B) $Q + p_0\left(\frac{1}{\rho_1} - \frac{1}{\rho_2}\right)$

(C) $Q + p_0\left(\frac{1}{\rho_2} - \frac{1}{\rho_1}\right)$ (D) $Q - p_0\left(\frac{1}{\rho_1} + \frac{1}{\rho_2}\right)$

CHEMISTRY

Q.41 (i) The slag obtained during the extraction is lighter and has lower melting point than the metal (Fe or Cu)

(ii) Froth floatation process may be used to increase the concentration of mineral chalcopyrite's

(A) T, T (B) T, F

(C) F, T (D) F, F

Q.42 $PbS \xrightarrow[\Delta]{air} X$, $X + PbS \longrightarrow Pb + SO_2$

'X' is

(A) PbO

(B) PbO_2

(C) PbO and $PbSO_4$

(D) PbO_2 and PbO

Q.43 An inorganic compound (A) is formed on passing iodine gas through a concentrated liquor containing sodium sulphide and sodium sulphite. On adding a solution of (A) into the solution of cupric chloride a white precipitate is formed which dissolves in excess of (A) forming a compound (B). hence, compound (B) is

(A) $Na_2S_2O_3$

(B) $Cu_2S_2O_3$

(C) $[Cu(NH_3)_4]SO_4$

(D) $Na_4[Cu_6(S_2O_3)_5]$

Q.44 Na_2SO_4+dil HCl + $BaCl_2$ $\longrightarrow$ white ppt.

fuse this ppt on charcoal with Na_2CO_3 and and extract the soluble substance with H_2O ↓

Gas 'G' is evolved ← add dil H_2SO_4 and heat the solution ← aqueous solution

The gas 'G' will show which of the following properties

(A) turn lead acetate filter paper black

(B) turn acidified $K_2Cr_2O_7$ filter paper green

(C) decolourise the pink colour of Na_2CO_3 (aq.) to which few drops of phenolphthalein have been added

(D) all the above

Q.45 For the following parallel chain reaction

$A \xrightarrow{K_1 = 2 \times 10^{-3}\ s^{-1}} 4B$, $A \longrightarrow 3C$

what will be that value of overall half – life of A in minutes?

$\left[\text{Given that } \frac{[B]_t}{[C]_t} = \frac{16}{9}\right]$

(A) 3.3 (B) 6.3

(C) 3.6 (D) None

Q.46 $6I^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3I_2(aq) + Br^-(aq) + 3H_2O(\ell)$

These data were obtained when this reaction was studied.

$[I^-]$,M	$[BrO_3^-]$,M	$[H^+]$, M	Reaction rate mol L^{-1} s^{-1}
0.0010	0.0020	0.010	8.0×10^{-5}
0.0020	0.0020	0.010	1.6×10^{-4}
0.0020	0.0040	0.010	1.6×10^{-4}
0.0010	0.0040	0.020	1.6×10^{-4}

What are the units of the rate constant for this reaction ?

(A) s^{-1} (B) mol L^{-1} s^{-1}

(C) L mol^{-1} s^{-1} (D) L^2 mol^{-2} s^{-1}

Q.47 It is an experiment fact that :

DMG + Ni (II) salt + $NH_4OH \rightarrow$ Red ppt.

Which of the following is wrong about this red ppt

(A) It is a non-ionic complex

(B) It involves Intra molecular H– bonding

(C) Ni(II) is sp^3 hybridised

(D) It is a diamagnetic complex

Q.48 When the complex

$K_6[(CN)_5Co–O–O–Co(CN)_5]$ is oxidised by bromine into

$K_5[(CN)_5Co–O–O–Co(CN)_5]$. Then which of the following statements will be true about this change

(A) Co (II) is oxidised in Co(III)

(B) The $O-O$ bond length will increase

(C) The $O-O$ bond length will decrease

(D) '*A*' & '*B*' Both are correct

Q.49 Electrolysis of a solution of HSO_4^- ions produces $S_2O_8^{2-}$. Assuming 75% current efficiency, what current should be employed to achieve a production rate of 1 mole of $S_2O_8^{2-}$ per hour ?

(A) +71.5 amp (B) 35.7 amp

(C) 142.96 amp (D) 285.93 amp

Q.50 You are given the following cell at 298 K,

$$Zn\left|\begin{matrix}Zn^{++}{}_{(aq.)}\\ 0.01\ M\end{matrix}\right|\left|\begin{matrix}HCl_{(aq.)}\\ 1.0\ \ Lit\end{matrix}\right|\left|\begin{matrix}H_2(g)\\ 1.0\ \ atm\end{matrix}\right|Pt$$

with $E_{cell} = 0.701$ and $E^0_{Zn^{2+}/Zn} = -0.76V$.

Which of the following amounts of NaOH (equivalent weight = 40) will just make the pH of cathodic compartment to be equal to 7.0

(A) 0.4 gms (B) 4 gms

(C) 10 gms (D) 2 gms

Q.51 How would you obtain a sol of AgI, the particles of which migrate toward cathode under the electric field?

(A) By adding little excess of KI to $AgNO_3$ solution

(B) By adding little excess of $AgNO_3$ to KI solution

(C) By mixing equal volumes of 0.010 M $AgNO_3$ and 0.010 M KI

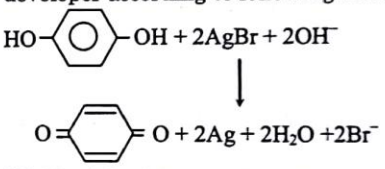
(D) None of these

Q.52 The shortest distance between sodium ions in NaCl crystal is *X*. The shortest distance between chloride ions in NaCl crystal is

(A) X (B) $\sqrt{2}X$

(C) $2\sqrt{2}X$ (D) $2X$

Q.53 In photography, quionole is used as developer according to following reaction



Which of the following describe(s) the role of quinol in this reaction

(A) it acts as an acid

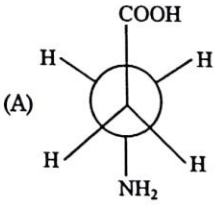
(B) It acts a weak base

(C) It acts as an oxidising agent

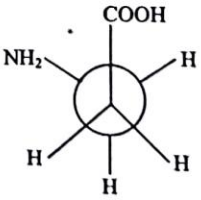
(D) It acts as a reducing agent

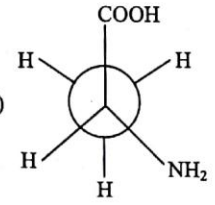
Q.54 Which of the following is the most stable conformation of 3-Aminopropanoic acid

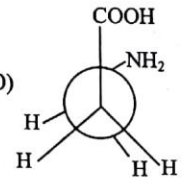
(A)



(B)

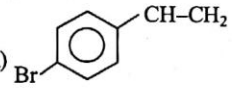


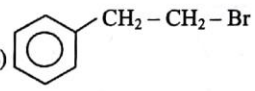
(C)


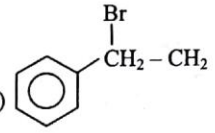
(D)


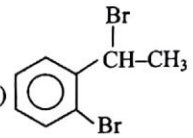
Q.55 The major product of the following reaction is –

$Ph-CH=CH_2$ (Styrence) $\xrightarrow[(PhCO)_2O_2]{HBr,\Delta}$

(A) 

(B) 

(C) 

(D) 

Q.56 $Ph-Br \xrightarrow{Mg/Et_2O} \xrightarrow{CO_2} \xrightarrow{H_3O^+}$

Product is

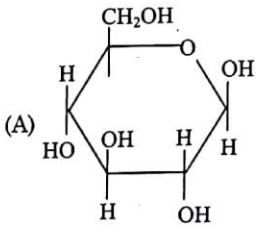
(A) Benzaldehyde

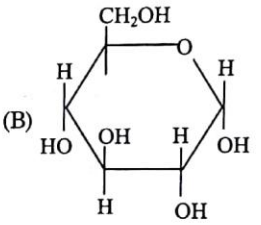
(B) Benzylalcohol

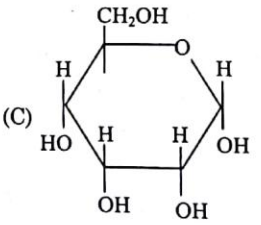
(C) Benzoic Acid

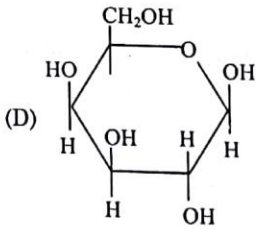
(D) p- Bromo benzoic acid

Q.57 Most stable conformation of D-Glucose is

(A) 

(B) 

(C) 

(D) 

Q.58 Toluene reacts with a halogen in the presence of iron (III) chloride giving ortho and para halo compound. The reaction is :

(A) Electrophilic elimination reaction

(B) Electrophilic substitution reaction

(C) Free radical addition reaction

(D) Nucleophilic substitution reaction

Q.59 Which is the correct match for the polymers with their type of linkage present in them

Column-I	Column-II
(1) Terylene	(a) Glycosidic linkage
(2)Cellulose	(b) Ester linkage
(3) Protein	(c) Phosphodiester linkage
(4) RNA	(d) Amide linkage

(A) 1-b, 2-d, 3-a, 4-c (B) 1-a, 2-b, 3-d, 4-c
(C) 1-b, 2-a, 3-d, 4-c (D) 1-b, 2-a, 3-c, 4-d

Q.60 Which is the correct increasing order of boiling points of the following compounds?
1-Iodobutane, 1-Bromobutane,
1-Chlorobutane, Butane
(A) Butane < 1-Chlorobutane <1-Bromobutane <1-Iodobutane
(B) 1- Iodobutane < 1- Bromobutane <1- Chlorobutane <1-Butane
(C) Butane < 1-Chlorobutane <1-Bromobutane <1-Iodobutane
(D) Butane < 1-Chlorobutane <1-Bromobutane <1-Iodobutane

BIOLOGY

Q.61 Primary producer are -
(A) Photoautotrophs
(B) Chemoautotrophs
(C) Both
(D) None

Q.62 ATP production in plants occurs in -
(A) light reaction
(B) dark reaction
(C) photorespiration
(D) none

Q.63 Dental formula of child of age 4 year (deciduous teeth)
(A) $\frac{2102}{2103}$ (B) $\frac{2101}{2101}$
(C) $\frac{2102}{2102}$ (D) $\frac{2123}{2123}$

Q.64 Bile salts -
(A) Break down polypeptide chains
(B) emulsify fats and solublize them
(C) digest fats
(D) help breakdown of polysaccharides

Q.65 Animals which excretes uric acid (uricotelic) are -
(A) land insects, birds, mammals
(B) Amphibians, birds, fish
(C) Insects birds, reptile
(D) reptile, fish, mammals

Q.66 Anemia is -
(A) Reduction in number of R.B.C.
(B) Reduction in amount of Hb in body
(C) Reduction in all type of blood cells
(D) A & B both

Q.67 Hormone release from post pituitary -
(A) Growth hormone
(B) Gonadotropins
(C) Oxytocin
(D) TSH

Q.68 Breast-Feeding by new born baby is example of -
(A) Unconditioned reflex
(B) Conditioned reflex
(C) Spinal reflex
(D) None

Q.69 "Cretinism" is due to -
(A) Hyposecretion of pituitary
(B) Hypersecretion of adrenal gland
(C) Hyposecretion of thyroid gland
(D) Hyperscretion of thyroid gland

Q.70 All are "STD" except -
(A) AIDS (B) Syphilis
(C) Gonorrhea (D) Tetanus

Q.71 Blood group of Humans are -
(A) Autosomal dominant
(B) Co-dominant
(C) Recessive
(D) Sex-linked

Q.72 Natural selection is the evolutionary process given by -
(A) Lamarck
(B) Darwin
(C) Hugodevries
(D) Weismann

Q.73 Homologous organ are -
(A) Fins of fishes and flipper of whale
(B) Wings of insect and wings of birds
(C) Fore limbs of man and horse
(D) None

Q.74 Paleontology is -
(A) Study of Radiation of life
(B) Study of evolutionary process
(C) Study of fossil
(D) Study of heredity character

Q.75 Entomophily is -
(A) Pollination by birds
(B) Pollination by insects
(C) Pollination by man
(D) Pollination by snails

Q.76 In Down's syndrome of a male-child, the sex complement is -
(A) XO (B) XY
(C) XX (D) XXY

Q.77 In human beings 45 chromosomes/single X/XO abnormality causes -
(A) Down's syndrome
(B) Klinefelter's syndrome
(C) Turner's syndrome
(D) Edward's syndrome

Q.78 Down's syndrome is due to -
(A) crossing over
(B) linkage
(C) sex-linked inheritance
(D) nondisjunction of chromosomes

Q.79 A colour blind mother and normal father would have -
(A) colour blind sons and normal carrier daughters
(B) colour blind sons and daughters
(C) all colour blind
(D) all normal

Q.80 Albinism is a congenital disorder resulting from the lack of which enzyme ?
(A) tyrosinase
(B) xanthine oxidase
(C) catalase
(D) fructokinase

PART-II [Two Marks Questions]

MATHEMATICS

Q.81 a, b, c are three natural numbers such that L.C.M. of pairs (a, b), (b, c), (c, a) are 100, 200, 200 respectively, then number of ways of selecting a, b, c is -
(A) 35 (B) 12 (C) 33 (D) 20

Q.82 If $x, y \in R$ then minimum value of $x^2 + 2xy + 3y^2 - 6x - 2y$ is -
(A) 0 (B) -4 (C) -11 (D) -8

Q.83 If p, q, r, s, t are numbers such that $p + q < r + s$, $q + r < s + t$, $r + s < t + p$, $s + t < p + q$ then the largest and the smallest numbers are -
(A) p and q respectively
(B) r and t respectively
(C) r and q respectively
(D) q & p respectively

Q.84 Number of ordered triplet (x, y, z) for which
$x^3 + y^3 + z^3 - 3xyz = 4$, where $x, y, z \in N$, are -
(A) 1 (B) 2
(C) 3 (D) 8

Q.85 Let $A = \{0, 1, 2, 3, \ldots 9\}$ be a set consisting of different digits. The numbers of ways in which a nine digit number can be made in which 1 and 2 are present and 1 is always ahead of 2 and repetition of digits is not allowed, is -

(A) 130.7! (B) 260.7!

(C) 288.7! (D) 210.7!

Q.86 From any point on the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, tangents are drawn to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 2$. The area cut off by the chords of contact on the region between the asymptotes is equal to -

(A) $4ab$ (B) $2ab$

(C) ab (D) $\frac{ab}{2}$

Q.87 The number of solution of the equation $\sin^{-1}\frac{ax}{c} + \sin^{-1}\frac{bx}{c} = \sin^{-1} x$ is, where $a^2 + b^2 = c^2$, a, b, c are positive real number -

(A) 1 (B) 2

(C) 3 (D) 4

Q.88 The number of solution of equation $\sin\{x\} = \cos\{x\}$ in the interval $[-2\pi, 2\pi]$ is, where $\{x\}$ denotes the fractional part of 'x'.

(A) 0 (B) 6

(C) 12 (D) 13

Q.89 If the number of points with integral co-ordinates that lie in the region given by $x^2 + y^2 < 16$ and $y^2 < 4x$ is λ, then sum of digit in λ is equal to -

(A) 4 (B) 5

(C) 7 (D) 9

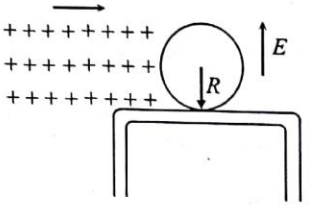
Q.90 A is a 3×3 matrix with entries from the set $\{-1, 0, 1\}$. Then the probability that A is neither symmetric nor skew-symmetric is -

(A) $\frac{3^9 + 3^6 - 3^3 + 1}{3^9}$ (B) $\frac{3^9 - 3^6 - 3^3 + 1}{3^9}$

(C) $\frac{3^9 - 3^6 + 3^3 + 1}{3^9}$ (D) $\frac{1}{2}$

PHYSICS

Q.91 Figure shows a metal ball of mass 50 kg and radius $\frac{2}{\sqrt{\pi}}$ m is placed on an insulating uncharged stand. In space an upward electric field 5×10^5 N/C is switched on. A stream of light ions is incident on the ball from left side at a speed 2×10^6 m/s as shown in figure, If charge on ball at $t = 0$ was zero, find the time in seconds at which ball will be lifted from the stand. The charge density of ion beam is 5×10^{-12} coul/m^3. Assume that all charge incident on the ball is absorbed

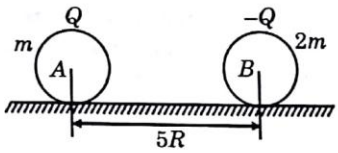


(A) 10 sec. (B) 15 sec.

(C) 20 sec. (D) 25 sec.

Q.92 Two smooth spherical non conducting shells each of radius R having uniformly distributed charge Q & $-Q$ on their surfaces are released on a smooth non-conducting surface when the distance between their centres is 5 R. The mass of A is m and that of B is 2 m. The speed of A just before A and B collide is :

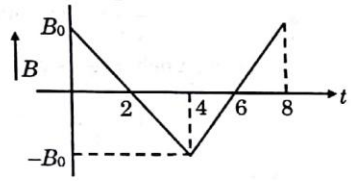
[Neglect gravitational interaction] (take $K = \frac{1}{4\pi\epsilon_0}$)



(A) $\sqrt{\frac{2kQ^2}{5mR}}$ (B) $\sqrt{\frac{4kQ^2}{5mR}}$

(C) $\sqrt{\frac{8kQ^2}{5mR}}$ (D) $\sqrt{\frac{16kQ^2}{5mR}}$

Q.93 In the graph variation of magnetic field with time 't' applied perpendicular to the plane of the ring is shown :



(A) at t = 2 sec and current flowing in ring is equal to zero

(B) current will change its direction two times in time intervals t = 0 to t = 8 sec

(C) current will change its direction only once in the above interval

(D) flux in ring is same at t = 0 & t = 4 sec

Q.94 The xz plane separates two media A and B with refractive indices μ_1 & μ_2 respectively. A ray of light travesls from A to B. Its directions in the two media are given by the unit vectors, $\vec{r_A} = a\hat{i} + b\hat{j}$ & $\vec{r_B} = \alpha\hat{i} + \beta\hat{j}$ respectively where $\hat{i}$ & $\hat{j}$ are unit vectors in the x & y directions. Then :

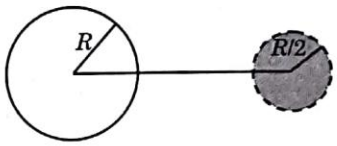
(A) $\mu_1 a = \mu_2 \alpha$

(B) $\mu_1 \alpha = \mu_2 a$

(C) $\mu_1 b = \mu_2 \beta$

(D) $\mu_1 \beta = \mu_2 b$

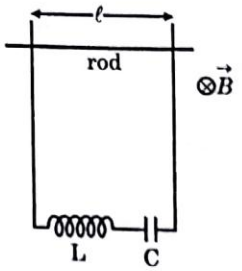
Q.95 A ring of radius R having a linear charge density λ moves towards a solid imaginary sphere of radius $\frac{R}{2}$, so that the centre of ring passes through the centre of sphere. The axis of the ring is perpendicular to the line joining the centres of the ring and the sphere. The maximum flux through the sphere in this process is :



(A) $\frac{\lambda R}{\epsilon_0}$ (B) $\frac{\lambda R}{2\epsilon_0}$

(C) $\frac{\lambda \pi R}{4\epsilon_0}$ (D) $\frac{\lambda \pi R}{3\epsilon_0}$

Q.96 Figure shows a conducting horizontal rod of resistance r is made to oscillates simple harmonically with a fixed amplitude in a uniform and constant magnetic field B, directed inwards. The ends of rod always touch two parallel fixed vertical conducting rails. The ends of rails are joined by an inductor and a capacitor having self inductance and capacitance $\frac{1}{\pi}$ Henry and $\frac{1}{\pi}$ farad respectively. The amplitude of current in the circuit depends on the frequency of oscillation of rod. The amplitude of the current will be maximum when the time period of rod is : (do not consider self inductance anywhere other than in the inductor)



(A) 0.5 sec (B) 1 sec

(C) 2 sec (D) 4 sec

Q.97 The distance between two slits in a Young's double slit experiment is 3 mm. The distance of the screen from the slits is 1 m. Microwaves of wavelength 1 mm are incident on the plane of the slits normally. The distance of the first maxima on the screen from the central maxima will be :

(A) 33.33 cm (B) 35.35 cm

(C) 17.7 cm (D) 18 cm

Q.98 Half lives of two isotopes X and Y of a material are known to be 2×10^9 years and 4×10^9 years respectively. If a planet was formed with equal number of these isotopes, then the current age of planet, given that currently the material has 20% of X and 80% of Y by number, will be :

(A) 2×10^9 years (B) 4×10^9 years

(C) 6×10^6 years (D) 8×10^9 years

Q.99 When a metallic surface is illuminated with monochromatic light of wavelength λ, the stopping potential is $5V_0$. When the same surface is illuminated with light of wavelength 3λ, the stopping potential is V_0. Then the work function of the metallic surface is :

(A) $\frac{hc}{6\lambda}$ (B) $\frac{hc}{5\lambda}$

(C) $\frac{hc}{4\lambda}$ (D) $\frac{2hc}{4\lambda}$

Q.100 An isolated and charged spherical soap bubble has a radius 'r' and the pressure inside is atmospheric. If 'T' is the surface tension of soap solution, then charge on drop is :

(A) $2\sqrt{\frac{2rT}{\varepsilon_0}}$ (B) $8\pi r\sqrt{2rT\varepsilon_0}$

(C) $8\pi r\sqrt{rT\varepsilon_0}$ (D) $8\pi r\sqrt{\frac{2rT}{\varepsilon_0}}$

CHEMISTRY

Q.101 For the reaction $A(g) + 3B(g) \rightleftharpoons 2C(g)$ at 27°C, 2 moles of A, 4 moles of B and 6 moles of C are present in 2 litre vessel. If K_c for the reaction is 1.2, the reaction will proceed in :

(A) forward direction

(B) backward direction

(C) neither direction

(D) none of these

Q.102 For the zero order reaction $A \rightarrow B + C$; initial concentration of A is 0.1 M. If $A = 0.08$ M after 10 minutes, then it's half-life and completion time are respectively :

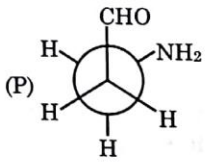
(A) 10 min; 20 min

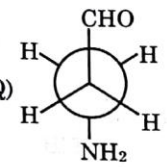
(B) 2×10^{-3} min; 4×10^{-3} min

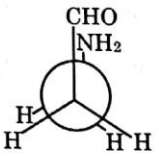
(C) 25 min; 50 min

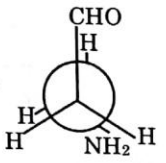
(D) 250 min; 500 min

Q.103 Consider the following conformations of 3-Aminopropanal :

(P) 

(Q) 

(R) 

(S) 

Amongst the above conformation (P,Q, R, S) one of them is most stable. This can be attributed due to -

(I) H-bonding in the conformer

(II) Gauche conformation in the conformer

(III) Anti conformation in the conformer

(IV) Larger groups being separated by maximum distance in the conformer

Then correct option is -

(A) II & IV (B) I and II

(C) III & IV (D) I & IV

Q.104 Which of the following will have the highest coagulating power for $Fe(OH)_3$ colloid ?

(A) PO_4^{3-} (B) SO_4^{2-} (C) Ca^{2+} (D) Al^{3+}

Q.105 The hybridization of the central atom will change when :

(A) NH_3 combines with H^+

(B) H_3BO_3 combines with OH^-

(C) NH_3 forms NH_2^-

(D) H_2O combines with H^+

Q.106 The spontaneous redox reaction/s among the following is/are –

(a) $2Fe^{3+} + Fe \rightarrow 3Fe^{++}$

(b) $Hg_2^{++} \rightarrow Hg^{++} + Hg$

(c) $3AgCl + NO + 2H_2O \rightarrow 3Ag + 3Cl^- + NO_3^- + 4H^+$

Given that

$E^o_{Fe^{+++}/Fe^{++}} = 0.77$ V $\quad E^o_{Fe^{++}/Fe} = -0.44$ V

$E^o_{Hg_2^{++}/Hg} = 0.85$ V $\quad E^o_{Hg^{++}/Hg_2^{++}} = 0.92$ V

$E^o_{AgCl/Ag} = 0.22$ V $\quad E^o_{NO_3^-/NO} = 0.96$ V

(A) a (B) a, b, c

(C) a, b (D) a, c

Q.107 Select the correct statement :

(A) If $[H^+] = y \times 10^{-x}$ then $pH = x - \log y$

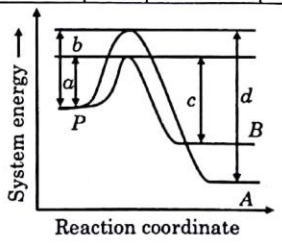
(B) If $[H^+] = \frac{1}{y} \times 10^{-x}$ then $pH = x + \log y$

(C) pH of a solution = 14 + log [OH-]

(D) All of the above

Q.108 Consider the decay of P to A and B by two parallel first order reactions as shown in figure. Given

Reaction	ΔH	Rate constant	Energy of Activation
$P \rightarrow A$	ΔH_A	k_A	E_A
$P \rightarrow B$	ΔH_B	K_B	E_B



Which of the following is incorrect ?

(A) $a = E_B$

(B) $b = E_A$

(C) $\Delta H_A = b - d$

(D) $\Delta H_B = c - a$

Q.109 Nitrogen is obtained by the thermal decomposition of -

(A) NH_4Cl

(B) NH_4NO_3

(C) $AgNO_3$

(D) none of these

Q.110 Which of the following oxyacid has $P - P$ bond(s) ?

(A) $H_4P_2O_7$ (B) $H_4P_2O_5$

(C) $(HPO_3)_3$ (D) $H_5P_3O_{10}$

BIOLOGY

Q.111 Which of the following criteria does not pertain to facilitated transport ?

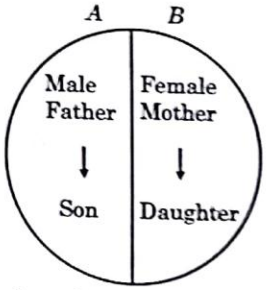
(A) High selectivity

(B) Transport saturation

(C) Uphill transport

(D) Requirement of special membrane proteins

Q.112



The above diagram is inheritance pattern of a certain type of traits in human, which one of the following condition may be an example of diagram (A)

(A) Diandric

(B) Halondric

(C) Digynic

(D) Hologynic

Q.113 Rice has a diploid genome with $2n = 24$. If crossing over is stopped in a rice plant and then selfed seeds are collected, will all the off springs be genetically identical to the parent plant ?

(A) yes, because crossing-over is the only source of genetic variation

(B) no, because stopping of crossing over a automatically increases rate of point mutation

(C) yes, only if the parent plant was a completely inbred line

(D) yes, only if the parent plant was a hybrid between two prue-bred lines

Q.114 Which one of the following is a wrong statement regarding mutations

(A) Triplet nature of genetic code is proved by frame shift mutation

(B) Cancer cells always form tumours due to chromosomal aberrations

(C) Mustard gas & nitrous acid are chemical mutagens

(D) Alter the single base of DNA causes point mutation

Q.115 As compared to dicot stem, a monocot stem has :

(A) Absence of bundle sheath around vascular bundle

(B) More abundant secondary xylem

(C) More conspicuous annual rings

(D) Lysigenous cavity below protoxylem

Q.116 Which sequence is correct in the evolution of history of man ?

(A) Pliopithecus → Proconsul → Dryopithecus → Oreopithecus → Ramapithecus → Austrolopithecus → Homoerectus → early Homo sapiens → Neanderthal → Cro-magnon → Modern man

(B) Proconsul → Pliopithecus → Dryopithecus → Ramapithecus → Oreopithecus → Aurtralopithecus → Homoerectus → Neanderthal → Early homo sapiens → Cro-magnon → Modern man

(C) Dryopithecus → Ramapithecus → Oreopithecus → Homoerectus → Neanderthal → Early homo sapiens → Modern man

(D) Pliopithecus → Proconsul → Ramapithecus → Homoerectus → Neanderthal → Early homo sapies → Cro.magnon → modern man

Q.117 Match the following list of bacteria and their commercially important products :

Bacteria	**Product**
(i) Aspergillus niger	(a) Lactic acid
(ii) Acetobacter aceti	(b) Butyric acid
(iii) Clostridium butylicum	(c) Acetic acid
(iv) Lactobacillus	(d) Citric acid

Choose the correct match.

(A) i-b, ii-c, iii-d, iv-a

(B) i-b, ii-d, iii-c, iv-a

(C) i-d, ii-c, iii-b, iv-a

(D) i-d, ii-a, iii-c, iv-b

Q.118

Column-I	**Column-II**
(A) Neoplasm	(I) Initiation of new tumour
(B) Benign tumour	(II) Bone, cartilage tissue cancer
(C) Carcinoma	(III) Malignant tumour
(D) Sarcoma	(IV) Cancer of epithelial tissue

(A) A-iii, B-i, C-iv, D-ii

(B) A-ii, B-i, C-iv, D-iii

(C) A-i, B-iii, C-iv, D-ii

(D) A-i, B-ii, C-iv, D-iii

Q.119 Match the following and choose the correct options :

A. Trophoblast	i. Embedding of blastocyst in the endometrium
B. Cleavage	ii. Group of cells that would differentiate as embryo
C. Inner cell mass	iii. Outer layer of blastocyst attached to the endometrium
D. Implantation	iv. Mitoic division of Zygote

Options :

(A) A-ii, B-i, C-iii, D-iv

(B) A-iii, B-iv, C-ii, D-i

(C) A-iii, B-i, C-ii, D-iv

(D) A-ii, B-iv, C-iii, D-i

Q.120 Which one of the following is the correct statement regarding the particular psychotropic drug specific :

(A) Morphine leads to delusions and disturbed emotions

(B) Barbiturates cause relaxation and temporary euphoria

(C) Hashish causes after thought perceptions and hallucinations

(D) Opium stimulates nervous system and causes hallucinations

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-1

Hints & Solutions

Answer key

1.(C)	2.(D)	3.(B)	4.(A)	5.(B)	6.(B)	7.(C)	8.(D)	9.(C)	10.(B)	11.(C)	12.(B)	13.(A)	14.(A)
15.(D)	16.(D)	17.(A)	18.(C)	19.(A)	20.(B)	21.(D)	22.(D)	23.(D)	24.(D)	25.(C)	26.(D)	27.(B)	28.(D)
29.(B)	30.(A)	31.(B)	32.(B)	33.(C)	34.(D)	35.(C)	36.(C)	37.(A)	38.(C)	39.(A)	40.(B)	41.(B)	42.(D)
43.(D)	44.(D)	45.(A)	46.(B)	47.(C)	48.(B)	49.(B)	50.(B)	51.(B)	52.(D)	53.(B)	54.(C)	55.(C)	56.(D)
57.(A)	58.(B)	59.(B)	60.(C)	61.(A)	62.(C)	63.(C)	64.(D)	65.(B)	66.(A)	67.(B)	68.(B)	69.(B)	70.(B)
71.(B)	72.(C)	73.(C)	74.(B)	75.(C)	76.(B)	77.(D)	78.(A)	79.(B)	80.(A)	81.(B)	82.(D)	83.(C)	84.(C)
85.(A)	86.(A)	87.(D)	88.(B)	89.(B)	90.(A)	91.(D)	92.(B)	93.(C)	94.(C)	95.(B)	96.(C)	97.(D)	98.(A)
99.(B)	100.(C)	101.(D)	102.(A)	103.(B)	104.(C)	105.(C)	106.(B)	107.(C)	108.(C)	109.(A)	110.(A)	111.(D)	112.(A)
113.(D)	114.(A)	115.(A)	116.(C)	117.(A)	118.(A)	119.(B)	120.(B)						

PART-I [One Mark Questions]

MATHEMATICS

1.[C] $y = n\,\ell n\,x,\ n > 1,\ n \in N$

$$A(n) = \int_1^e n\ell nx\,dx = n$$

$\therefore\ A(n) + n\,A\,(n-1) = n^2.$

2.[D] $\sqrt{1-x} > \sqrt{1+x} \qquad (-1 \le x \le 1)$

$1 - x > 1 + x$

$x < 0$

$\therefore\ x \in [-1, 0)$

3.[B] ${}^mC_3 + {}^mC_4 > {}^{m+1}C_3$

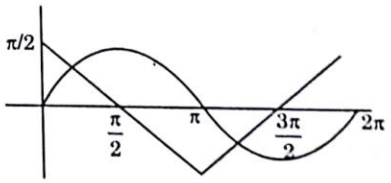
$\Rightarrow\ {}^{m+1}C_4 > {}^{m+1}C_3$

$\Rightarrow\ \dfrac{(m+1)!}{(m-3)!\,4!} > \dfrac{(m+1)!}{(m-2)!\,3!} \Rightarrow m - 2 > 4$

$\Rightarrow\ m > 6 \Rightarrow$ The least value of m is 7.

4.[A] $x = \sqrt{-2 + 2x} \Rightarrow x^2 - 2x + 2 = 0$

5.[B]



this is continuous every where but not differentiable

6.[B] $I = \displaystyle\int_{-1}^{1} \frac{x^3}{x^2 + 2|x| + 1}\,dx + \int_{-1}^{1} \frac{|x|+1}{(|x|+1)^2}\,dx$

$$= 0 + 2\int_0^1 \frac{dx}{1+x} = 2\,\ell n\,2$$

7.[C] The system of equations will have unique solution if $D \neq 0$

8.[D] $f(x) = (ax^2 + b)^3 = y \Rightarrow x = \pm\left(\frac{y^{\frac{1}{3}} - b}{a}\right)^{\frac{1}{2}}$

$\therefore \quad g(x) = \left(\frac{x^{1/3} - b}{a}\right)^{1/2}$

9.[C] Centre of circle through P, Q, R and S can be given as

$\left(\frac{x_1 + x_2 + x_3 + x_4}{2}, \frac{y_1 + y_2 + y_3 + y_4}{2}\right)$

and centroid of triangle PQR is

$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$

Hence orthocenter is $(-x_4, -y_4)$.

10.[B] $I = \int \frac{dx}{x^6\left(1 + x^{-5}\right)^{4/5}}$

$= \int \frac{x^{-6}\,dx}{\left(1 + x^{-5}\right)^{4/5}}$

put $x^{-5} = t$

$\frac{-5}{x^6}\,dx = dt$

$= \frac{-1}{5}\int \frac{dt}{(1+t)^{4/5}} = -\frac{1}{5}(1+t)^{1/5} + c$

$= -\frac{1}{5}(1 + x^{-5})^{1/5} + c$

11.[C] $\lim_{x\to 0} \frac{3^{6x} - 3^{5x} - 3^{4x} + 3^{2x} + 3^x - 1}{x^3}$

$= \lim_{x\to 0} \frac{(3^x - 1)(3^{5x} - 3^{3x} - 3^{2x} + 1)}{x^3}$

$= \lim_{x\to 0} \frac{(3^x - 1)(3^{2x} - 1)(3^{3x} - 1)}{x^3}$

$= (\ell n3)\,(2\ell n3)\,(3\ell n3) = 6(\ell n3)^3$

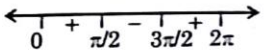
12.[B] $\because \quad f(x) = e^x.\sin x$

$f'(x) = e^x \sin x + e^x \cos x$

$f''(x) = e^x \sin x + 2e^x \cos x - e^x \sin x$

$= 2e^x \cos x = 0$

$\Rightarrow \quad x = \frac{\pi}{2}, \frac{3\pi}{2}$



$\therefore \quad f'(x)$ is maximum at $x = \pi/2$

13.[A] $1 + [g(x)]^5$

14.[A] Let $y = f(x)$

$\therefore \quad f^{-1}(y) = x$

$f^{-1'}(y) \cdot y' = 1$

$f^{-1''}(y) = -\frac{y''}{(y')^2}$

$\because \quad y' < 0 \;\&\; y'' > 0$

$\therefore \quad f^{-1'}(y) < 0 \;\&\; f^{-1''}(y) > 0$

15.[D] $S = 0 + 1 + 2 + 3 + \ldots\ldots + 998 + 999$

$S = 999 + 998 + \ldots\ldots + 1 + 0$

$2S = 999 + 999 + \ldots\ldots$ (1000 times)

(sum of the digits being 27 in each case)

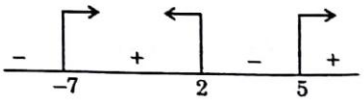
$= \quad 1000 \times 27 \Rightarrow S = 13501$

16.[D] $P(A/A \cup B) = \frac{P(A)(A \cup B)}{P(A \cup B)}$

$= \frac{P(A)}{P(A) + P(B)} = \frac{0.10}{0.10 + 0.32}$

17.[A] $\frac{(x-5)}{x^2 + 5x - 14} > 0$

$\frac{(x-5)}{(x+7)(x-2)} > 0$



$x \in (-7, 2) \cup (5, \infty)$

Smallest integer x is -6

18.[C] $\Rightarrow$ x, y, z are in H.P.

$\Rightarrow$ y = H.M. of x and z $\quad \because$ G.M. > H.M.

$\Rightarrow \sqrt{xz} > y$

Again, Since A.M. > G.M.

(here x, y, z are unequal)

$\therefore \frac{x^3 + z^3}{2} > \sqrt{(xz)^3} > y^3 \Rightarrow x^3 + z^3 > 2y^3$

19.[A] $\tan A + \tan B + \tan C = \tan A \tan B \tan C > 0$

$\Rightarrow$ either all of $\tan A$, $\tan B$ & $\tan C$ are +ve or two are –ve. But in any triangle two angles are never obtuse

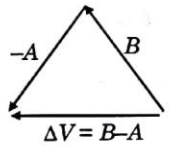
$\therefore$ $\tan A, \tan B, \tan C > 0$

20.[B] Consider $|\hat{e}_1 - \hat{e}_2|^2 = 2 - 2\cos\theta = 4\sin^2\frac{\theta}{2}$

$\therefore \frac{1}{2}|\hat{e}_1 - \hat{e}_2| = \sin\frac{\theta}{2}$

PHYSICS

21.[D]



The direction of acceleration is the same as the direction of the changes in velocity, according to $a = \frac{v_f - v_i}{t}$. Because $\Delta v = v_f - v_i$, we can determine Δv graphically by adding v_f to the negative of v_i, or $B + (-A)$. Placing the B vector "tip-to-tail" with the $-A$ vector gives a direction for Δv (and therefore, a) to the left

22.[D] The falling object, when released from rest, has an initial acceleration of 9.8 m/s² (if near the surface of the earth). As its velocity increases, it collides with air molecules at an increasing rate, thus reducing the rate at which it accelerates. (The acceleration is usually modeled as a function of v or v^2. depending on a number of factors.) The acceleration continues to decrease until the acceleration of the object is 0, at which point the velocity of the falling object remains constant. The only graph consistent with this analysis is d, where the acceleration curve can be seen to be approaching zero asymptotically.

23.[D] This is a conservation of momentum problem, in which the total momentum of the glider at the beginning of the problem is equal to the sum of the momenta of the individual gliders at the end of the problem

$Mv = m_1v_1' + m_2v_2'$

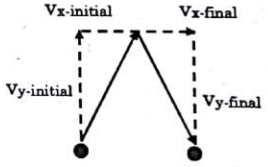
$Mv = \frac{1}{4}Mv_1' + \frac{3}{4}Mv_2'$

$v = \frac{1}{4}v_1' + \frac{3}{4}v_2'$

$v_2' = \frac{4}{3}(v - \frac{1}{4}v_1')$

$v_2' = \frac{4}{3}(2 - \frac{1}{4}5') = 1$ m/s.

24.[D] The billiard ball has velocity vectors in both the x and y directions, as shown here. The x-component of the velocity remains unchanged, but the y-component has changed from the positive to the negative direction, a change in velocity — and thus, momentum — in the negative y direction.



25.[C] The overall momentum of the system at the beginning of the problem is 0, and with no external forces applied, this will continue to be the total momentum of the system. During the ball's motion to the right, the cart will have a motion to the left. However, once the cannonball is caught by the trap, they have the same velocity, which has to be zero if linear momentum is to be conserved

$m_{cart}v_{cart} + m_{cannonball}v_{cannonball} = m_{cart}v_{cart} + m_{cart}v_{cart}$

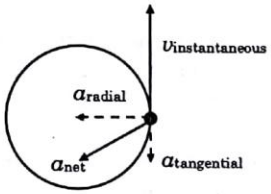
$(m_{cart} + m_{cannonball})v_{initial} = (m_{cart} + m_{cannonball})v_{final}$

$(m_{cart} + m_{cannonball})$ (0 m/s) $= (m_{cart} + m_{cannonball})v_{final}$

$v_{final} = 0$ m/s

26.[D] The instantaneous velocity of the object is tangent to its circular path, and we know that there's a radial (centripetal) aspect of the net acceleration that points towards the center of the circular path. Thus, we can conclude that the object is traveling in a circular path that is located to its left, as shown here.

We can also see that the net acceleration must include a tangential component of acceleration that is in the opposite direction of the instantaneous velocity, implying that the object is slowing down as it travels along this circular path.



27.[B] This is a conservation of energy problem, and the total mechanical energy of the system remains constant :

$U_i + K_i = U_f + K_f$

$4.0\ J + 1.0\ J = -2.0\ J + K_f$

$K_f = 7.0\ J$

28.[D] According to conservation of angular momentum, the angular momentum L of the star remains constant, so when its moment of inertia I increases (due to the decreased radius), its angular velocity w goes up proportionally, according to :

$L_{initial} = L_{final}$

$I_i\omega_i = I_f\omega_f$

$\omega_f = \frac{I_i}{I_f}\omega_i$

The star's rotational kinetic energy, based on $K_{rotational} = \frac{1}{2}I\omega^2$ also goes up.

Although I has decreased, $K_{rotational}$ increases with the square of w, leading to a net increase in energy.

29.[B] He nucleus revolving in circle behave as current carrying coil of $i = \frac{q}{T} = \frac{2e}{T}$

$$B_{at\ center} = \frac{\mu_0 i}{2R} = \frac{\mu_0}{2R} \times \frac{2e}{T} = \frac{\mu_0 e}{TR}$$

$$= \frac{\mu_0 \times 1.6 \times 10^{-19}}{2 \times 0.8} = \mu_0 \times 10^{-19}$$

30.[A] $B_W = B$ due to wire

B_E = Magnetic field due to earth

$B_{Net\ Q} = B_W - B_E$

$B_{Net\ P} = B_W + B_E$

$\therefore\ B_{Net\ P} > B_{Net\ Q}$

31.[B] Magnetic force on wire $= i(\vec{\ell} \times \vec{B})$

where $\vec{\ell} = \ell\hat{i}$ (as wire is lying along x-axis)

$\vec{B} = B.(\hat{i} + \hat{j} + \hat{k})$

$\therefore\ \vec{F} = I\vec{\ell} \times \vec{B} \Rightarrow = I\ell(\hat{i}) \times B_0(\hat{i} + \hat{j} + \hat{k})$

$\vec{F} = B_0 I\ell(\hat{k} - \hat{j})$

$\Rightarrow\ \vec{F} = \sqrt{2}B_0 I\ell$

32.[B] $\vec{F}_m = q\vec{v} \times \vec{B}$

$m\vec{a} = q\vec{v} + \vec{B} \Rightarrow \vec{a} \perp \vec{v}$ so $\vec{a}.\vec{v} = 0$

$\Rightarrow\ (x\hat{i} + 7\hat{j}).(7\hat{i} - 3\hat{j}) \times 10^{-3} = 0$

$7x - 21 = 0$

$x = 3$

33.[C] Power $= V_{rms} \times i_{rms} \cos\phi \qquad \left(\phi = \frac{\pi}{3}\right)$

$$\text{Power} = \frac{100}{\sqrt{2}} \times \frac{100 \times 10^{-3}}{\sqrt{2}} \times \cos\frac{\pi}{3}$$

$$= \frac{10000 \times 10^{-3}}{2} \times \frac{1}{2} = 2.5\ \text{Watt}$$

34.[D] For isolated systems, all three conservation laws are always in effect : total energy is conserved (although kinetic energy K is not conserved in this perfectly inelastic collision), linear momentum is conserved, and angular momentum is conserved.

35.[C] The kinetic energy lost in the collision can be found by subtracting the skater's final K from their initial K:

$$K_{initial} = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$$

$$K_{final} = \frac{1}{2} (m_1 + m_2) v_f^2$$

$$\Delta K = K_{final} - K_{initial}$$

$$\Delta K = \left(\frac{1}{2}(m_1 + m_2) v_f^2\right) - \left(\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2\right)$$

$$\Delta K = \left(\frac{1}{2}(30 + 80)\left(\frac{100 kg \bullet m/s}{110 kg}\right)^2\right) - \left(\frac{1}{2}(30kg)(2m/s)^2 + \frac{1}{2}(80kg)(1m/s^2)\right)$$

$$\Delta K = 45\ J - (60 + 40) = -55 J$$

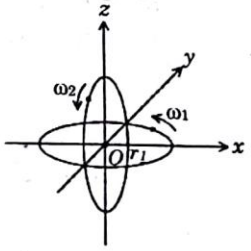
36.[C] Since a monoatomic gas molecule has 3 degrees of freedom, the molar heat capacity (also called molar specific heat) of the monatomic gas at constant volume (C_V) is (3/2) R where R is universal gas constant. Its molar heat capacity at constant pressure (C_p) is (5/2) R. This follows from Meyer's relation, $C_p = C_v + R$. This means that when heat energy equal to (5/2) R joule is supplied to one mole of a monatomic gas to make it expand at constant pressure. (3/2) R joule is used to increase the temperature by 1 K and the remaining R joule is used for doing work against the forces which oppose the expansion. 3/2 is 60% of 5/2.

37.[A] In the fundamental mode the air column in the open pipe (pipe open at both ends) vibrates with consecutive antinodes at its ends so that the length L of the pipe is equal to $\lambda/2$ where λ is the wave length of sound in air. Therefore, $\lambda = 2L$.
The air column in the closed pipe (pipe closed at one end) on the other hand vibrates in its fundamental mode, with a node at the closed end (at the water surface inside the pipe) and the neighbouring antinode at the open end so that $L/2 = \lambda/4$. Again we obtain $\lambda = 2L$. The frequencies in the two cases are same.

38.[C] Considering the vertical motion of the projectile (pebble), the time taken to reach the ground after leaving the wheel is given by
$2R = 0 + (1/2)gt^2$, from which $t = 2\sqrt{(R/g)}$
[We have used the equation of the one dimensional motion, $x = x_0 + v_0 t + (1/2)\, at^2$]
The horizontal range of the pebble is
PQ = horizontal velocity × time of flight
The centre of mass of the wheel is moving with speed u. The pebble at the topmost point of the wheel is moving horizontally with speed u with respect to the wheel so that the horizontal velocity of the pebble with respect to the ground is $u + u = 2u$.
Therefore, horizontal range
$PQ = 2u \times 2\sqrt{(R/g)} = 4u\sqrt{(R/g)}$

39.[A] The position vector r_1 of the particle at the instant t is given by
$r_1 = v_0 t + 1/2 at^2$ where v_0 is the initial velocity and a is the constant acceleration
We have $v_0 = 2\hat{j}$ and $a = 2\hat{i} + 4\hat{j}$
Therefore,
$r_1 = 2\hat{j}\, t + (1/2)\,(2\hat{i} + 4\hat{j})t^2 = t^2\hat{i} + (2t + 2t^2)\,\hat{j}$
The above equation shows that the x-coordinate of the particle at time t is t^2 and the y-coordinate is $(2t + 2t^2)$
The time t at which the y-coordinate becomes 12 metre is given by $2t + 2t^2 = 12$
Or, $2t^2 + 2t - 12 = 0$
This gives $t = [-2 \pm \sqrt{(4 + 96)}]/4 = 2$ seconds, ignoring the negative time.
Since the x-coordinate of the particle is t^2, its value when the y-coordinate becomes 12 m (at time 2 seconds) is 4m.

40.[B] Let us consider any two particles of the body. Let a particle of the first body rotate in the x-y plane in a circle of radius r_1.
Similarly, let a particle of body 2 move in the y-z plane in a circle of radius r_2 as shown in the figure.



Then $\vec{\omega}_1 = \omega_1 \hat{k}$ and $\vec{\omega}_2 = \omega_2 \hat{i}$
$\vec{\omega}_{21} = \vec{\omega}_2 - \vec{\omega}_1 = \omega_2 \hat{i} - \omega_1 \hat{k}$
$\therefore\ |\vec{\omega}_{21}| = \sqrt{\omega_1^2 + \omega_2^2}$

CHEMISTRY

41.[B] When copper ore is mixed with silica, in a reverberatory furnace copper matte is produced. The copper matte contains sulphides of copper (I) and iron (II).

42.[D] On heating with concentrated NaOH solution in an inert atmosphere of CO_2, white phosphorus gives PH_3 gas.

43.[D] scc : $a = 2r$; bcc : $\sqrt{3a} = 4r$; fcc : $\sqrt{2a} = 4r$

44.[D] $A \longrightarrow$ Product

We know, Rate $= K$ [conc.]^n

$1 \times 10^{-4} = K\,[.01]^n$ ...(i)

$1.41 \times 10^{-4} = K\,[.02]^n$ ...(ii)

(i) / (ii) $\quad \dfrac{1}{1.41} = \left(\dfrac{1}{2}\right)^n$

$n = \dfrac{1}{2}$

Then $\quad \dfrac{-d(A)}{dt} = K\,[A]^{1/2}$

45.[A] $Na_2[Cr\ (edta)]$ is correct representation.

46.[B] Aluminium hydroxide is a +ve sol, so –ve ions are effective in coagulation.

47.[C] Interstitial compounds are generally chemically inert

48.[B]

$Cu^{2+} + 1e^- \rightarrow Cu^+ \quad E_1^0 = 0.15\ v\ \Delta G_1^0 = -n_1\ E_1^0\ F$

$Cu^{2+} + 1e^- \rightarrow Cu \quad E_2^0 = 0.50\ v\ \Delta G_2^0 = -n_2\ E_2^0\ F$

$Cu^{2+} + 2e^- \rightarrow Cu \quad \Delta G^\circ = \Delta G^\circ_1 + \Delta G^\circ_2$

$(-1)n\ E^\circ\ F = (-1)\ n_1\ E_1^0\ F + (-1)\ n_2 E_2^0\ F$

$E^\circ = \dfrac{n_1E_1^0 + +n_2E_2^0}{n} = \dfrac{0.15\times1 + 0.50\times1}{2}$

$= 0.325V$

49.[B] $2Na_2S_2O_3 + \underset{Unexposed}{AgBr} \rightarrow Na_3[Ag(S_2O_3)_2] + NaBr$

This property is used for fixing in photography.

50.[B] Since, the graph of t vs $(a - x)^{-1}$ is a straight line, it must be a second order reaction.

$\therefore \quad K = \dfrac{1}{t}\left[\dfrac{1}{(a-x)} - \dfrac{1}{a}\right]$

or $\quad \dfrac{1}{a-x} = Kt + \dfrac{1}{a}$

On comparing, slope

$K = \tan\theta = 0.5\ mol^{-1}L\ min^{-1}$

$OA = \dfrac{1}{a} = 2\ L\ mol^{-1}$

or $\quad a = 0.5\ mol\ L^{-1}$

Rate $= K(a)^2 = 0.5 \times (0.5)^2$

$= 0.125\ mol\ L^{-1}\ min^{-1}$.

51.[B] Flocculation power $\propto \dfrac{1}{Coagulation\ value}$

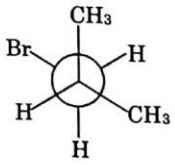
P	:	Q	:	R
$\frac{1}{3}$	:	$\frac{1}{0.6}$	:	$\frac{1}{0.8}$
1	:	5	:	37.5

52.[D] $H_2S + (CH_3COO)_2Pb \longrightarrow \underset{black}{PbS} + 2CH_3COOH$

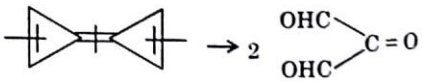
$PbS + 4H_2O_2 \longrightarrow \underset{white}{PbSO_4} + 4H_2O$

53.[B] Body diagonal contain two atoms at corners (A), one octahedral void (C) and two tetrahedral voids (D).

54.[C]



55.[C]



56.[D] Terminal alkyne form white ppt. with Tollen's reagent.

57.[A] Rate of electrophilic substitution $\propto$ Stability of arenium ion.

58.[B] Nucleophilicity ∝ Size (in group)

59.[B]

$$CCl_3\text{–}\underset{\underset{O}{\|}}{C}\text{–H} > CBr_3\text{–}\underset{\underset{O}{\|}}{C}\text{–H} > CH_3\text{–}\underset{\underset{O}{\|}}{C}\text{–H} > CH_3\text{–}\underset{\underset{O}{\|}}{C}\text{–}CH_3$$

60.[C] Enantiomeric excess

$$= \frac{\textit{Excess of one enantiomer over other}}{\textit{Entire mixture}} \times 100$$

$$= \frac{6-4}{6+4} \times 100 = 20\%$$

BIOLOGY

61.[A] One, two

62.[C] Presence of closely arranged parenchymatous cells

63.[C] i and iii

64.[D] Bivalents separate from each other at the site of crossing over

65.[B] i, ii and iii

66.[A] Leaves

67.[B] Mesophyll cell as the site of primary carboxylation

68.[B] Meiosis does not occur in haploid cells

69.[B] F1 resembled either of the two parents

70.[B] a and c

71.[B] Activated sludge cannot be used in anaerobic digestion process

72.[C] Phytoplanktons have shorter life span and high annual productivity

73.[C] Regions with accelerated habitat loss

74.[B] Many fructose molecules

75.[C] Agrobacterium tumefaciens

76.[B] Increase the surface area

77.[D]

Vas deferens	Semina vesicle	Prostate	Bulboure-thral gland

78.[A] Genetical disorders

79.[B] Single parent type and attack specific antigen

80.[A] IUDs (Intra uterine devices)

PART-II [Two Marks Questions]

MATHEMATICS

81.[B] Given,

$$1 \geq |z-(4-3i)| \geq \begin{cases} |z|-|4-3i| \\ |4-3i|-|z| \end{cases}$$

$\Rightarrow |z| \leq 6$ and $|z| \geq 4$

$\Rightarrow 4 \leq |z| \leq 6 \Rightarrow \alpha = 4, \beta = 6$

Let $y = \dfrac{x^4+x^2+4}{x} = x^3 + x + \dfrac{4}{x}$

$= x^3 + x + \dfrac{1}{x} + \dfrac{1}{x} + \dfrac{1}{x} + \dfrac{1}{x}$

Since $x \in (0, \infty)$, therefore

$x^3, x, \dfrac{1}{x}$ are positive.

Sum will be least when $x^3 = x = \dfrac{1}{x}$

$\Rightarrow x = 1$

$\therefore k = 6$

Hence, $k = \beta$

82.[D] Total number of bulbs = 200

Total number of defective bulbs

$= 1(7-6) + 2(6-5) + 3(5-4) + 4(4-3) + 5(3)$

$= 25.$

Answer is $\dfrac{25}{175} = \dfrac{1}{7}$.

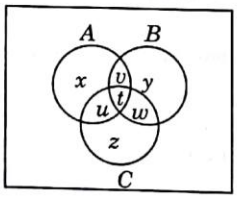
83.[C] $S = (p+q-r)^n$ {Putting $x = y = z = 1$}

$$\lim_{n\to\infty} \frac{S}{(S^{1/n}+1)^n} = \lim_{n\to\infty} \frac{(p+q-r)^n}{\{(p+q-r)+1\}^n}$$

$$= \lim_{n\to\infty} \left(\frac{p+q-r}{(p+q-r+1)}\right)^n = 0$$

$$\left\{as \left(\frac{p+q-r}{p+q-r+1}\right) < 1\right\}$$

84.[C]



$\frac{1}{5} = x + v + y$

$\frac{1}{15} = w$

$\frac{1}{10} = u + t$

$x + y + z + u + v + w + t = 1$

$z = 1 - \frac{1}{5} - \frac{1}{15} - \frac{1}{10} = \frac{19}{30}$

85.[A] $4 \tan\frac{B}{2} \tan\frac{C}{2} = 1$

$\frac{s-a}{s} = \frac{1}{4}$

Solve it $b + c = 10$

Focus F_1 (2, 0) and F_2(8, 0) and $2a = 10$;

$2ae = 6$; $e = 3/5$; $b = 4$

$\frac{(x-5)^2}{25} + \frac{y^2}{16} = 1$

86.[A] $\frac{d}{dx}(g'(x)e^{-3x}) > 3.e^{-3x}$

$\Rightarrow \frac{d}{dx}(g'(x)e^{-3x} + e^{-3x}) > 0$

$\Rightarrow e^{-3x}(1 + g'(x))$ is an increasing function.

Now, $e^{-3x}(1 + g'(x)) > (g'(0) + 1) \Rightarrow x > 0$

$\Rightarrow g'(x) + 1 > 0$

$\Rightarrow g(x) + x$ is an increasing function.

87.[D] $\because \sqrt{1+\sin 14} > 1 \Rightarrow n_3 > n_4$

$\sqrt{1+\sin 14} = \sqrt{(\sin 7 + \cos 7)^2}$

$= \sin 7 + \cos 7$ & $\sqrt{\sin 7} > \sin 7$

$\sqrt{\cos 7} > \cos 7$

$\therefore n_2 > n_1 = n_3 > n_4$

88.[B] Since, matrix A is skew-symmetric.

$\therefore |A| = 0$

$\therefore |A^4 . B^3| = 0$

89.[B] $f(x) = ae^{2x} + be^x + cx$

Since, $f(0) = a + b$

i.e., $a + b = -1$ ....(i)

$f'(x) = 2ae^{2x} + be^x + c$

$\therefore f'(\log 2) = 2ae^{2\log 2} + be^{\log 2} + c$

$= 8a + 2b + c$

$= 8a + 2b + c = 31$ ....(ii)

$\int_0^{\ell n 4} (ae^{2x} + e^x + cx - cx)dx$

$= \int_0^{\ell n 4} (ae^{2x} + be^x)dx$

$= \left(\frac{ae^{2x}}{2} + be^x\right)_0^{\ell n 4}$

$= \frac{ae^{2\ell n 4}}{2} + be^{\ell n 4} - \frac{a}{2} - b$

$= 8a + 4b - \frac{a}{2} - b = \frac{15a}{2} + 3b$

$= \frac{39}{2}$

i.e., $15a + 6b = 39$ ....(iii)

from equation (i), (ii) & (iii)

$9a = 45$

$\therefore a = 5, b = -6$ and $c = 3$

90.[A] $T_n = \frac{1}{n^2 + (n-2)} = \frac{1}{(n+2)(n-1)}$,

$n = 3, 4, 5, ...$

$= \frac{1}{3}\left[\frac{1}{n-1} - \frac{1}{n+2}\right]$

$\therefore S = \sum_{n=3}^{\infty} T_n = \frac{1}{3}\left(\frac{1}{2} - \frac{1}{5}\right) + \frac{1}{3}\left(\frac{1}{3} - \frac{1}{6}\right)$

$+ \frac{1}{3}\left(\frac{1}{4} - \frac{1}{7}\right) + \frac{1}{3}\left(\frac{1}{5} - \frac{1}{8}\right)$

: :

.....

$S = \frac{1}{3}\left[\frac{1}{2} + \frac{1}{3} + \frac{1}{4}\right] = \frac{1}{3}\left[\frac{6+4+3}{12}\right] = \frac{13}{36}$

PHYSICS

91.[D] $\frac{1}{f} = (\mu_{rd}-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$\frac{1}{2} = (1.5-1)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$

$\therefore \left[\frac{1}{R_1}-\frac{1}{R_2}\right] = 1$

now in medium

$\frac{1}{f} = \left(\frac{1.5}{1.25}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$\frac{1}{f} = \frac{0.25}{1.25}\times 1 \qquad \therefore f_2 = 5$ cm

92.[B] Let I_r be the rms current through the ircuit then

$I_r = 2A$, $\frac{I_r}{\omega C} = 20V$, $I_r \omega L = 20V$ and $I_r R = 10$ V

Solving we get

$R = 5\Omega$, $C = \frac{1}{\pi}\times 10^{-3}$ F and $L = \frac{1}{10\pi}$ H

$\therefore$ V_S = source voltage

$$= I_r\sqrt{R^2+\left(\omega L-\frac{1}{\omega C}\right)^2}$$

$$= \sqrt{(I_r R)^2+\left(I_{,r}\,\omega L-\frac{1}{\omega C}\right)^2}$$

$$= \sqrt{10^2+(20-20)^2} = 10 \text{ volts}$$

Now, after the inductor is shorted

$$I_r = \frac{v_s}{\sqrt{R^2+\frac{1}{\omega^2C^2}}} = \frac{10}{\sqrt{25+100}} = \frac{10}{\sqrt{5}}$$

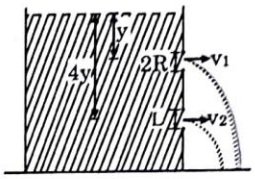
ampere

$v_1 = I_r R = 2\sqrt{5}$ volts

$v_2 = \frac{I_r}{\omega C} = 4\sqrt{5}$ volts **Ans.**

93.[C] Removed part has more mass near its circumference (away from O). So after its removal centre of mass should move nearer to i.e. $a < d$.

94.[C] Let v_1 and v_2 be the velocity of efflux from square and circular hole respectively. S_1 and S_2 be cross-section areas of square and circular holes.



$v_1 = \sqrt{8gy}$ and $v_2 = \sqrt{2g(y)}$

The volume of water coming out of square and circular hole per second is

$Q_1 = v_1 S_1 = \sqrt{8gy}\ L^2$;

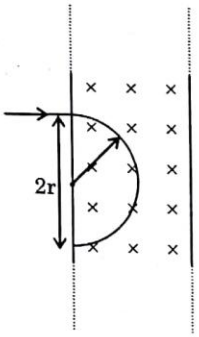
$Q_2 = v_2 S_2 = \sqrt{2gy}\ \pi R^2 \because Q_1 = Q_2$

$\therefore R = \sqrt{\frac{2}{\pi}}\,.\,L$

95.[B] Electromagnetic force will provide the necessary centripetal force.

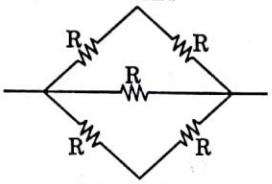
$evv = \frac{mv^2}{r}$

$r = \frac{mv^2}{qB} = \frac{v}{B\alpha} = \frac{(2\alpha d)(B)}{(B\alpha)} = 2d$



i.e. the electron will move out after traveling on a semicircular path of radius r = 2d. Hence (B)

96.[C] $\frac{dQ}{dt} = \frac{KA\Delta T}{2\ell} = \frac{\Delta T}{\frac{2\ell}{KA}} = \frac{10}{120}$ J /sec.

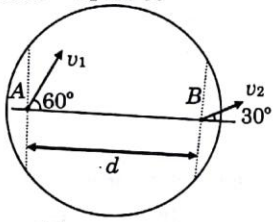


New rate $\frac{dQ}{dt} = \frac{\Delta T}{\frac{\ell}{2KA}} = \frac{40}{120}$ J /sec. ;

So time taken is $t = \frac{20}{40} \times 120$ sec. = 60 sec.

97.[D] For rigid body separation between two point remains same.

$v_1 \cos 60° = v_2 \cos 30°$



$\frac{v_1}{2} = \frac{\sqrt{3}v_2}{2} \Rightarrow v_1 = \sqrt{3}\, v_2$

$\omega_{disc} = \left|\frac{v_2 \sin 30° - v_1 \sin 60°}{d}\right| = \left|\frac{\frac{v_2}{2} - \frac{\sqrt{3}v_1}{2}}{d}\right|$

$= \left|\frac{v_2 - \sqrt{3} \times \sqrt{3}v_2}{2d}\right| = \frac{2v_1}{2d} = \frac{v_2}{d}$

$\Rightarrow \omega_{disc} = \frac{v_2}{d}$

98.[A] For chain to move with constant speed P needs to be equal to frictional force on the chain. As the length of chain on the rough surface increases. Hence the friction force $f_k = \mu_k N$ increases.

99.[B] $V_1 = \frac{v^2}{u^2} V_0$ & $v = \frac{uf}{-u-f} \Rightarrow \frac{-f}{u+f} = \frac{v}{u}$

$V_{rel} = V_0 - V_i = \left(1 - \frac{v^2}{u^2}\right) V_0 = \left[1 - \left(\frac{f}{f+u}\right)^2\right]$

V_0 as u increases v_{rel} decreases

100.[C] $\phi = \vec{E} \cdot \vec{ds}$

since $r << R$ so we can consider electric field is constant throughout the surface of smaller ring, hence

$\phi \propto E \propto \frac{x}{(R^2 + x^2)^{3/2}}$

So, the best represented graph is C.

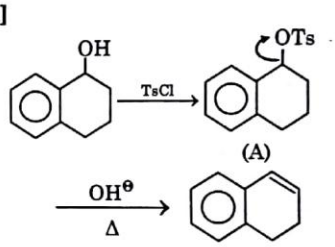
CHEMISTRY

101.[D] $\beta \rightarrow Z$ increases by 1 unit

$\alpha \rightarrow Z$ decreases by 2 & A by 4

In emission of V radiation only energy decrease

102.[A]



Elimination

103.[B] $k = \frac{2.303}{t} \log\left(\frac{r_\infty - r_0}{r_\infty - r_t}\right)$

$= \frac{2.303}{30} \log\left(\frac{-11-34}{-11-19}\right)$

$= 1.35 \times 10^{-2}$ min^{-1}

if solution is optically inactive $r_t = 0$

$t = \frac{2.303}{k} \log\left(\frac{-45}{-11}\right) = 103.7$ min

104.[C] 1° Amine forms ppt with TsCl which is soluble in KOH

105.[C] $H_2S \rightleftharpoons 2H^+ + S^{2-}$

$K_{a_1}.K_{a_2} = \frac{[H^+]^2[S^{2-}]}{[H_2S]} = \frac{(10^{-3})^2[S^{-2}]}{0.1}$

$\Rightarrow [S^{2-}] = \frac{10^{-21} \times 0.1}{(10^{-3})^2} = 10^{-16}$

$E_{S^{2-}|Ag_2S|Ag}$

$= E^\circ_{Ag^+/Ag} - \frac{0.0591}{2} \log \frac{[S^{2-}]}{[K_{sp}]}$

$= 0.8 - \frac{0.0591}{2} \log \frac{10^{-16}}{10^{-49}} = -0.19\ V$

106.[B] $\Lambda_m(HC) = \Lambda_m(HCl) + \Lambda_m(NaC) - \Lambda_m(NaCl)$
$= 426 + 83 - 126 = 383\ \Omega^{-1}\ cm^2\ mol^{-1}$
molar conductivity of HC

$$\Lambda_m(HC) = \frac{k}{C}$$

$$= \frac{3.83\times10^{-5}\Omega^{-1}cm^{-1}}{0.001} \times 1000$$

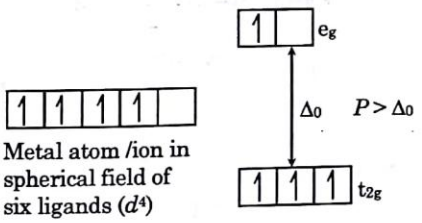
$= 38.3\ \Omega^{-1}cm^2\ mol^{-1}$

$$\alpha = \frac{\Lambda_m(HC)}{\Lambda_m^{\infty}(HC)} = \frac{38.3}{383} = 0.1$$

$$K_a = \frac{C\alpha^2}{1-\alpha} = \frac{10^{-3}\times0.1^2}{(1-0.1)} = 1.11\times10^{-5}$$

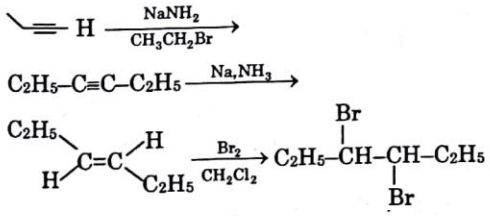
107.[C] Correct name of (1) →
Tris (acetylacetonato) iron (III)
Correct name of (2) →
Tetraammine dicyano platinum (IV) hexachloro palatinate (IV)
Correct name of (3) →
Dichloro (ethylenediamine) platinum (II)

108.[C]



Metal atom /ion in spherical field of six ligands (d^4)

109.[A]



110.[A] In O_2 of F_2 S-P mixing is not present in 14 e^- system or before 14 e^- system.
So option (A) is wrong.

BIOLOGY

111.[D] a → Pyruvic acid
b → $CO_2 + H_2O$
c → Lactic acid
d → Ethyl alcohol + CO_2

112.[A] a, b & c

113.[D]

Menstrual cycle	Endometrium	Estrous cycle	FSH

114.[A] (i) & (ii) only

115.[A] O positive

116.[C] a = s, b = r; c = p; d = q

117.[A] $\frac{27}{64}$

118.[A] GUA UAG GUA CUG UGA

119.[B] Gibberellic acid

120.[B] (i) Incorrect, (ii) Correct,
(iii) Incorrect, (iv) Correct

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-2

Stream – SX

Hints & Solutions

Answer key

1.(B)	2.(D)	3.(D)	4.(D)	5.(B)	6.(A)	7.(B)	8.(A)	9.(B)	10.(B)	11.(A)	12.(D)	13.(A)	14.(C)
15.(C)	16.(A)	17.(B)	18.(C)	19.(C)	20.(C)	21.(C)	22.(A)	23.(C)	24.(B)	25.(A)	26.(A)	27.(B)	28.(B)
29.(C)	30.(C)	31.(C)	32.(C)	33.(C)	34.(A)	35.(A)	36.(B)	37.(C)	38.(D)	39.(A)	40.(B)	41.(B)	42.(D)
43.(B)	44.(D)	45.(A)	46.(C)	47.(D)	48.(B)	49.(A)	50.(D)	51.(B)	52.(C)	53.(C)	54.(D)	55.(C)	56.(A)
57.(B)	58.(A)	59.(C)	60.(D)	61.(C)	62.(A)	63.(A)	64.(C)	65.(A)	66.(B)	67.(C)	68.(C)	69.(C)	70.(B)
71.(A)	72.(A)	73.(A)	74.(B)	75.(A)	76.(B)	77.(A)	78.(B)	79.(B)	80.(D)	81.(B)	82.(A)	83.(C)	84.(B)
85.(C)	86.(A)	87.(C)	88.(C)	89.(B)	90.(B)	91.(D)	92.(B)	93.(C)	94.(B)	95.(C)	96.(D)	97.(A)	98.(D)
99.(A)	100.(C)	101.(A)	102.(B)	103.(C)	104.(D)	105.(B)	106.(B)	107.(D)	108.(D)	109.(D)	110.(B)	111.(B)	112.(B)
113.(A)	114.(C)	115.(C)	116.(A)	117.(A)	118.(D)	119.(B)	120.(D)						

PART-I [One Mark Questions]

MATHEMATICS

1.[B] $am^2 + 2m + 1 = 0$

$m^2 + 2m + a = 0$

common root $m = 1$

other roots $= 1/a, a$; $a + 1 = -2 \Rightarrow a = -3$

$m^2 - (a + 1/a)m + 1 = 0$

$\Rightarrow x^2 - (a + 1/a)xy + y^2 = 0$

$\Rightarrow x^2 - \left(-3 - \frac{1}{3}\right)xy + y^2 = 0$

$\Rightarrow 3x^2 + 10xy + 3y^2 = 0$

2.[D] $\log_{1/4}\beta = -1 \Rightarrow \beta = 4$

$\log_{\beta}\alpha = -1 \Rightarrow \alpha = \frac{1}{\beta} = \frac{1}{4}$

$\gamma = \log_{\alpha}8 = \log_{1/4}8 = -\frac{3}{2}$

Now $\frac{1}{\alpha} + 1 = 4 + 1 = 5$

$\beta^2 + 4\gamma^2 = 16 + 4\left(-\frac{3}{2}\right)^2 = 25$

$\therefore \left(\frac{1}{\alpha} + 1\right)^{\log_{\sqrt{5}}(\beta^2 + 4\gamma^2)} = 5^{\log_{\sqrt{5}}25} = 625$

3.[D] Clearly $a > 1$

$b^2 - 10b + 25 > 1$

$b^2 - 10b + 24 > 0$

$b \in (-\infty, 4) \cup (6, \infty)$

4.[D] Mean of the combined group are

$M = \frac{63 \times 27.6 + 26 \times 19.2}{63 + 26} = 25.1$

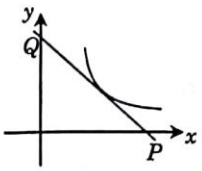
Thus A.M. is decreased by $27.6 - 25.1 = 2.5$

5.[B] Symmetric about $x = 4$

$2\left\{\left[\frac{x_1 + x_2}{2}\right] + \left[\frac{x_3 + x_4}{2}\right] + \left[\frac{x_5 + x_6}{2}\right] + \left[\frac{x_7 + x_8}{2}\right]\right\}$

$= 2\{4 + 4 + 4 + 4\} = 16 \times 2 = 32$

6.[A] $\because \sqrt{x}+\sqrt{y}=\sqrt{a}$



Slope of tangent at (x_1, y_1) is

$$\frac{1}{2}\frac{1}{\sqrt{x_1}}+\frac{1}{2}\frac{1}{\sqrt{y_1}}\left(\frac{dy}{dx}\right)=0 \Rightarrow \frac{dy}{dx}=\frac{-\sqrt{y_1}}{\sqrt{x_1}}$$

Equation of tangent is $y-y_1=\frac{-\sqrt{y_1}}{\sqrt{x_1}}(x-x_1)$

$\because$ Point P on x-axis is $(x_1+\sqrt{x_1y_1}\ ,\ 0)$

Point Q on y-axis is $(0,\ y_1+\sqrt{x_1y_1}\ )$

$\therefore OP+OQ=x_1+y_1+2\sqrt{x_1y_1}$

$=(\sqrt{x_1}+\sqrt{y_1}\ )^2\ =a$

7.[B] Solution of these three equations is infinite.

$-(4y+6z-5)+3(2x+3y+5z-5)$

$=6x+5y+9z-10$

So planes contain straight line.

8.[A] $y=\frac{x^2}{8}+x\cos x+\cos 2x$

$=\frac{x^2}{8}+x\cos x+2\cos^2 x-1$

$=2\left(\cos x+\frac{x}{4}\right)^2=-1.$

9.[B] $Re\left(\frac{z-2i+1-1}{z+1}\right)=1 \Rightarrow Re\left(\frac{-1-2i}{z+1}+1\right)=1$

$\Rightarrow Re\left(\frac{-1-2i}{z+1}\right)=0 \Rightarrow x+1+2y=0$

10.[B] Probability of A to not win $=1-\frac{1}{3}=\frac{2}{3}$

$P(B)=\frac{2}{3}\cdot\frac{3}{5}=\frac{2}{5}$

$P(C)=\frac{2}{3}\cdot\frac{2}{5}=\frac{4}{15}$

11.[A] Given, $\frac{dy}{dx}=\frac{y(x-y\ell ny)}{x(x\ell nx-y)}$

$\Rightarrow x^2\ell n\,x\,dy-xy\,dy=xy\,dx-y^2\,\ell n\,y\,dx$

$\Rightarrow \frac{\ell nx}{y^2}dy-\frac{1}{xy}dy=\frac{1}{xy}dx-\frac{\ell ny}{x^2}dx$

(on dividing by x^2y^2)

$\Rightarrow \frac{1}{xy}dx-\frac{\ell nx}{y^2}dy+\frac{1}{xy}dy-\frac{\ell n\,y}{x^2}dx=0$

$\Rightarrow d\left(\frac{\ell nx}{y}\right)+d\left(\frac{\ell ny}{x}\right)=C$

On integrating both sides, we get

$x\,\ell n\,x+y\,\ell n\,y=C\,xy$

12.[D] Perimeter $=b+a+10=x+y\cos z$

Using sine rule

$\frac{10\times 2}{\sqrt{3}}=\frac{a}{\sin 50^\circ}=\frac{b}{\sin 70^\circ}$

$a=\frac{20}{\sqrt{3}}\sin 50^\circ,\ b=\frac{20}{\sqrt{3}}\sin 70^\circ$

$a+b=\frac{20}{\sqrt{3}}(\sin 50^\circ+\sin 70^\circ)$

$=\frac{20}{\sqrt{3}}\,2\cos 10^\circ \sin 60^\circ$

$=20\cos 10^\circ$

Perimeter $10+a+b=10+20\cos 10^\circ$

$=x+y\cos z$

On comparing we get

$x+y+z=10+20+10=40$

13.[A] Hint: $[\vec{a}\,\vec{b}\,\vec{c}]=\vec{a}.(\vec{b}\times\vec{c})=\begin{vmatrix}a_1 & a_2 & a_3\\ b_1 & b_2 & b_3\\ c_1 & c_2 & c_3\end{vmatrix}$

$[\vec{a}\ \vec{b}\ \vec{c}]=(\vec{a}\times\vec{b})\,.\,\vec{c}$

$[\vec{a}\,\vec{b}\,\vec{c}]=\pm|\,\vec{a}\times\vec{b}\,|\,|\vec{c}\,|\cos 0 \quad \because\ \vec{c}\,||\,\vec{a}\times\vec{b}$

$[\vec{a}\ \vec{b}\ \vec{c}]^2=|\,\vec{a}\,|^2\,|\,\vec{b}\,|^2\ \sin^2\frac{\pi}{4}$

$[\vec{a}\,\vec{b}\,\vec{c}]^2=\frac{1}{2}|\,\vec{a}\,|^2\,|\,\vec{b}\,|^2$

$$\begin{vmatrix}a_1 & a_2 & a_3\\ b_1 & b_2 & b_3\\ c_1 & c_2 & c_3\end{vmatrix}^2=\frac{1}{2}(a_1^2+a_2^2+a_3^2)\,(b_1^2+b_2^2+b_3^2)$$

$\lambda=\frac{1}{2}$

14.[C] 7! onwards are divisible by 35. Hence remainder of (1! + 2! + 3! + 4! + 5! + 6!), when divided by 35 is $\frac{873}{35}=33$

15.[C] $(3^{x^2} - 3^{(x+6)})^2 = 0$

$\Rightarrow x^2 = x + 6$

$\Rightarrow (x^2 - x - 6) = 0$

$\Rightarrow (x - 3)(x + 2) = 0$

$\Rightarrow x = 3$ or $x = -2$

16.[A] $f(\theta) = \dfrac{(\cos\theta - \sin\theta)^2 + \cos^2\theta - \sin^2\theta}{2(\cos\theta - \sin\theta)(\cos\theta + \sin\theta)}$

$= \dfrac{\cos\theta}{\cos\theta + \sin\theta} = \dfrac{1}{1 + \tan\theta}$

$f(11°)\, f(34°) = \dfrac{1}{(1 + \tan 11°)(1 + \tan 34°)}$

$= \dfrac{1}{(1 + \tan 11°)} \dfrac{1}{1 + \tan(45° - 11°)}$

$= \dfrac{1}{(1 + \tan 11°)} \left(\dfrac{1}{1 + \dfrac{1 - \tan 11°}{1 + \tan 11°}} \right) = \dfrac{1}{2}$

17.[B] $f(-x) = \dfrac{\sin^2 x}{[-x/\pi] + 1/2} = \dfrac{\sin^2 x}{-1 - [x/\pi] + 1/2}$

$f(-x) = -\dfrac{\sin^2 x}{1/2 + [x/\pi]} = -f(x)$

odd function $\therefore$ Ans. = 0

18.[C] $\angle F = \alpha + \gamma$ & $\angle D = \angle\beta + \gamma$

Quadrilateral *AFED* is cyclic

$\Rightarrow \angle F + \angle D = 180° \Rightarrow \alpha + \beta + 2\gamma = 180°$

$\Rightarrow 2k + 3k + 4k = 180° \left\{ \text{let} \dfrac{\alpha}{2} = \dfrac{\beta}{3} = \dfrac{\gamma}{2} = k \right\}$

$\Rightarrow k = 20°$

$\Rightarrow \alpha + \beta + \gamma = 7k = 140°$

19.[C] It is possible if equation becomes identity

$\Rightarrow a^2 - 3a + 2 = 0 \Rightarrow a = 1, 2$

$a^2 - 4a + 3 = 0 \Rightarrow a = 1, 3$

$a^2 - 6a + 5 = 0 \Rightarrow a = 1, 5$

Common value of a is 1.

20.[C] $k - 1 + x = t$, $dx = dt$

$$\sum_{k=1}^{10} \int_{k-1}^{k} f(t)dt = \int_0^1 + \int_1^2 + \cdots + \int_9^{10} = \int_0^{10} f(t)dt = 5$$

PHYSICS

21.[C] Rotational K.E. =

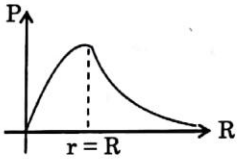
Rotational degree of freedom $\times \dfrac{1}{2}$ nRT

$= 2 \times \dfrac{1}{2}$ nRT = nRT = PV

$= PA \cdot \dfrac{V}{A}$ = force on piston (L + x)

$= kx\,(L + x)$

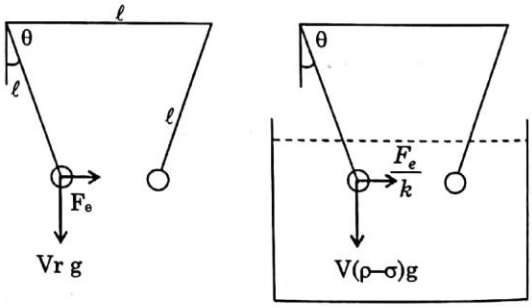
22.[A]



Power maximum when r = R.

So, Power consumed by it will decease for R > r.

23.[C]



$\tan\theta = \dfrac{F_e}{V\rho g} = \dfrac{F_e / k}{V(\rho - \sigma)g}$

$\Rightarrow k = \dfrac{\rho}{\rho - \sigma} = \dfrac{2.4}{2.4 - 0.8} = 1.5$

24.[B] Electric field of a point charge is non-uniform hence net force can never be zero.

Since $F = -\dfrac{pdE}{dx}$

25.[A] 5

26.[A] $\frac{1}{\lambda_\alpha} = \frac{3R}{4}(Z-1)^2 \Rightarrow (Z-1) = \sqrt{\frac{4}{3R\lambda_\alpha}}$

$= \sqrt{\frac{4}{3\times1.1\times10^7\times1.8\times10^{-10}}}$

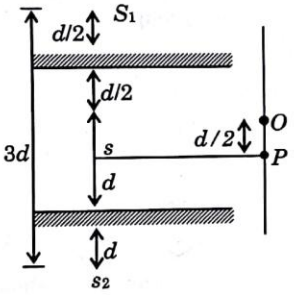
$= \frac{200}{3}\sqrt{\frac{5}{33}} = \frac{78}{3} = 26. \quad \Rightarrow = 27$

27.[B] The situation can be taken as if there are two sources S_1 and S_2 as shown in figure. Due to these S_1 and S_2, the central maxima will be at P at a distance d/2 from O.

Path difference = $\frac{3d.d}{2D} = n\lambda$

$\Rightarrow \lambda = \frac{3d^2}{2nD}$

ie. $\lambda = \frac{3d^2}{2D}, \frac{3d^2}{4D}$

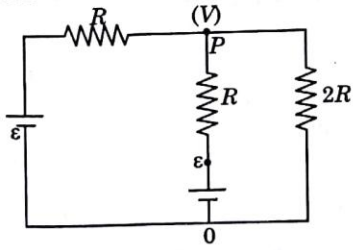


28.[B]

29.[C] Rate of change of momentum

$= F = m\frac{v^2}{r} \propto v^2$

30.[C] Just after switching, the capacitor will act like a conducting wire. So effective circuit will be



By applying KVL at point P

$\frac{V-\varepsilon}{R} + \frac{V-\varepsilon}{R} + \frac{V}{2R} = 0$

$V = \frac{4\varepsilon}{5}$

So, current in the branch containing capacitor = $\frac{\varepsilon}{5R}$.

31.[C] $\frac{M}{L} = \frac{q}{2m}$

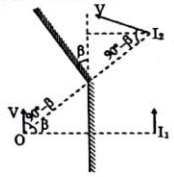
$M = \frac{q}{2m}.L$

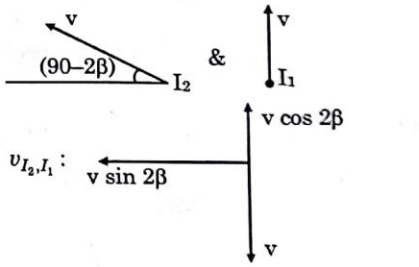
$M = \frac{q}{2m}.\frac{mL^2}{12}.\omega$

$M = \frac{qL^2\omega}{24}$

32.[C] Magnet will take longer time to travel through copper tube than iron tube

33.[C] From image diagram

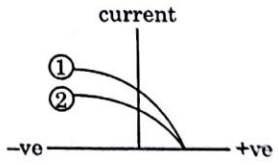




$\Rightarrow v_{I_1,I_1} = \sqrt{(v - v\cos 2\beta)^2 + (v\sin 2\beta)^2}$

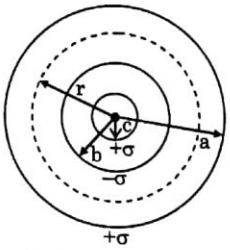
$= 2v \sin \beta$

34.[A]



35.[A] ratio of their amplitudes is 1

36.[B]



Electric field at a distance $r(a > r > b)$ will be due to charges enclosed in r only, & Since, a sphere acts as a point charge for points outside its surface,

$$\therefore E = \frac{kQ_c}{r^2} + \frac{kQ_b}{r^2} = \frac{k}{r^2}(\sigma \times 4\pi c^2 + (-\sigma)\, 4\pi b^2)$$

$$= \frac{\sigma}{\varepsilon_0 r^2}(c^2 - b^2)$$

37.[C] By right hand thumb rule; the field at P* due to to both the segments is inside the plane of the paper, i.e., along negative z-axis.

38.[D] 4 : 1

39.[A] $L = \dfrac{\mu_0 N^2 \pi r^2}{\ell}$

length of wire = N $2\pi r$ = Constant (= C, suppose)

$$\therefore \quad L = \mu_0 \left(\frac{C}{2\pi r}\right)^2 \frac{\pi r^2}{\ell} \quad \therefore L \propto \frac{1}{\ell}$$

$\therefore$ Self inductance will become 2L.

40.[B] $A_P = A_Q e^{-\lambda t} = A_Q e^{-\frac{1}{T}t} \quad \therefore t = T\ell n \dfrac{A_Q}{A_P}$

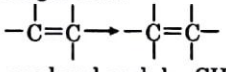
CHEMISTRY

41.[B] In polymerization of ethane

$n(H_2C{=}CH_2) \xrightarrow{\text{Polymerisation}} (-CH_2{-}CH_2-)_n$

Since, the no. of C–H bonds on both sides are equal. But n(C=C) changes to $2n$(C–C) bonds + 1.

or a C = C double bond changes to 3 C–C single bond



one bond each by CH_2 group C–C and one bond extra.

n(C=C) = 2n(C–C) + 1

Since n is very large as compared to 1

n(C=C) → 2n(C–C)

Enthalpy of polymerization

$= n(\Delta H_{C=C}) - 2n\Delta H_{C-C}$

$= n \times 590 - 2n \times 331 = -72n$

Enthalpy of polymerization per molecule

$$= \frac{\Delta H_{\text{polymerisation/mol}}}{n} = -\frac{72n}{n} = -72 \text{ kJ/mol}$$

42.[D] $3Ca + N_2 \rightarrow Ca_3N_2$

Metal(A) (B) calcium nitride

(The case of formation of nitrides decreases from Be → Ba)

$Ca_3N_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2NH_3$

(B) (C) (D)

cal. hydroxide

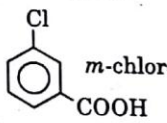
$Ca(OH)_2 + CO_2 \rightarrow CaCO_3\downarrow + H_2O$

Milkiness

43.[B] $\underset{(A)}{C_9H_7O_2Cl}$ exists in keto form and predominatly in enolic form must contain $-\overset{\overset{O}{\|}}{C}-CH_2-$ group

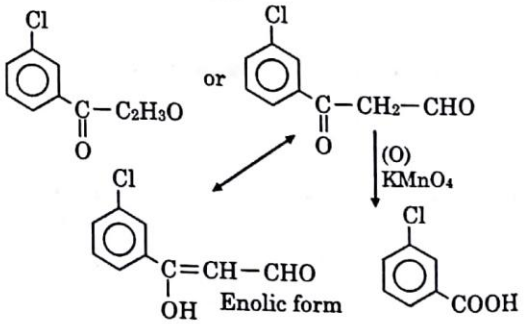
Oxidation of (A) gives m-chlorobenzoic acid

$C_9H_7O_2Cl\ (A) \xrightarrow[KMnO_4]{(O)}$



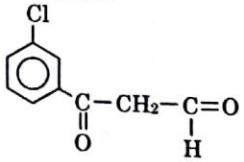
m-chlorobenzoic acid

Hence, the compound should have a skeleton struct



m-chlorobenzoic acid

Thus, A is



44.[D] $CH_3COOH \xrightarrow[\text{H.V.Z. reaction}]{P+Cl_2} ClCH_2COOH \xrightarrow[\text{in excess}]{NH_3} H_2N-CH_2COONH_4$

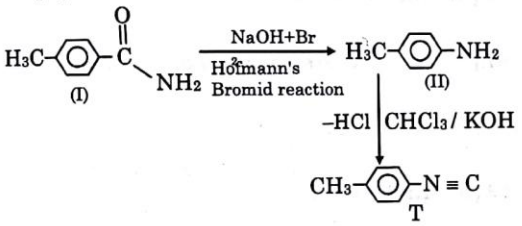
Acetic acid; α-Chloro acetic acid; Ammonium glycinate

45.[A] $C_6H_5-\underset{H}{C}=\boxed{O+H_2}CHCOOC_2H_5$

(Aldol like reaction)

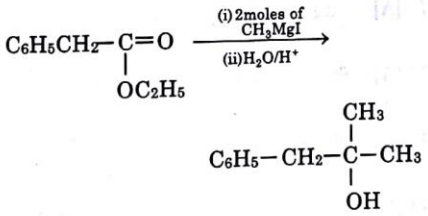
$\xrightarrow[\text{absolute ethanol } +\Delta]{NaOC_2H_5 \text{ in}} C_6H_5-CH=CH-COOC_2H_5$

46.[C]



Compound I undergo Hofmann's bromide reaction and followed by carbylamine reaction to give T as (3).

47.[D]



48.[B] $-\ddot{N}H-$ group due to +R or +M effect is always o- and p-direction in nature while $-\underset{}{C}=O$ is meta director, $-\ddot{N}H-$ group has precedence over $-\underset{}{C}=O$ group. Electrophile is $I^{\oplus}$

49.[A] $2NOBr \rightleftharpoons 2NO + Br_2$ Let initial pressure = P

P – 2x	2x	x	
P–0.4P	0.4P	0.2P	

1.2P = 0.3

P = 0.25 am

$K_p = \dfrac{p^2_{NOBr}}{p^2_{NO} \cdot p_{Br_2}} = 45$

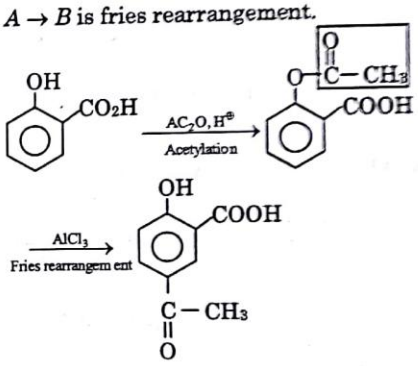
50.[D] $[H^+] = \sqrt{K_{a_1} \times C} = \sqrt{10^{-5} \times 0.1} = 10^{-3}$

$K_{a_3} = \dfrac{[H^+][A^{3-}]}{[HA^{-2}]} = 10^{-12}$

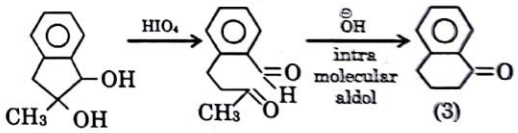
$\Rightarrow \dfrac{[A^{-3}]}{[HA^{-2}]} = 10^{-10}$

$pX = 10$

51.B] $A \rightarrow B$ is fries rearrangement.



52.[C]



(A)

53.[C]

Let x gm CaC_{24}

$CaC_2O_4 \xrightarrow{\Delta} CaCO_3 \xrightarrow{\Delta} CaO$

$\frac{x}{128}$ mole $\quad \frac{x}{128}$ mole $\quad \frac{x}{128}$ mole

Let 0.6 – x gm MgC_2O_4

$MgC_2O_4 \xrightarrow{\Delta} MgCO_3 \xrightarrow{\Delta} MgO$

$\frac{0.6-x}{112}$ mole $\quad \frac{0.6-x}{112}$ mole $\quad \frac{0.6-x}{112}$ mole

given $\dfrac{x}{128} \times 100 + \dfrac{0.6-x}{112} \times 84 = 0.465$

$\therefore$ x = 0.48 gm

weight of CaO + MgO

$= \dfrac{0.48}{128} \times 56 + \dfrac{0.12}{112} \times 40 = 0.252$ gm

54.[D] Mole of $H_2SO_4 = 0.1$, mole of KOH = 0.2

Mole of H_2O_2 used in first reaction

$$= \frac{0.2}{2} \times \frac{1}{0.4} = 0.25$$

Mole of produced $O_2 = \frac{6.74}{22.4} = 0.3$

Mole of H_2O_2 used in second reaction

$$= \frac{0.3}{3 \times 0.5} = 0.2$$

Total mole of consumed $H_2O_2 = 0.45$

Molarity of $H_2O_2 = \frac{0.45}{0.15} = 3$ M

Volume strength = $11.2 \times 3 = 33.6$

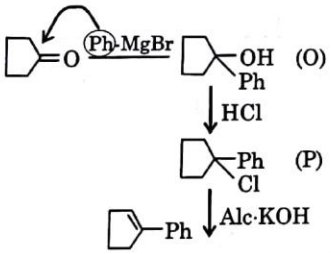
55.[C] Molecule is non planar and $\mu \neq 0$

56.[A] $\overset{14}{\underset{\alpha}{CH_3}}-CH=CH-CHO \xrightarrow{\overset{\ominus}{OH}}$

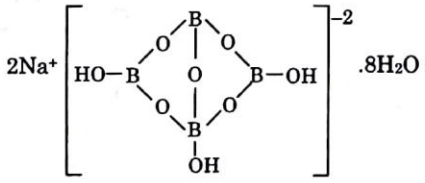
$\overset{14}{\underset{\alpha}{CH_2^{\ominus}}}-CH=CH-CHO \xrightarrow[CH_3CHO]{\gamma(\text{Gama}) \text{ aldol}}$

$CH_3-CH=\overset{14}{C}H-CH=CH-\overset{O}{\overset{\|}{C}}H$

57.[B]



58.[A]



59.[C] Froath floatation is used for sulphide ore.

60.[D] $C_A = C_{A_0} e^{-kt}$ Concentration show exponential decrease with time

BIOLOGY

61.[C] AIDS is an immunodeficiency disease

62.[A] IgE

63.[A] 1/16

64.[C] Non-ambiguity

65.[A] Birds, reptiles and insects

66.[B] Auxin decreases

67.[C] Melanocyte stimulating hormone (MSH)

68.[C] Mg and Fe

69.[C] Kreb's cycle

70.[B] The intermediate compound which links glycolysis with Krebs' cycle is malic acid

71.[A] Sugarcane

72.[A] Spinal cord

73.[A] Metaphase

74.[B] a and c are correct but b and d are wrong

75.[A] Grass → mice → snake → hawk

76.[B] Phosphorylation of glucose

77.[A] DNA

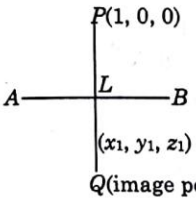
78.[B] spermatogonia, spermatocytes, spermatids, spermatozoa

79.[B] 3600 mL

80.[D] Cloning vector

PART-II [Two Marks Questions]
MATHEMATICS

81.[B]



Q(image point) $PL = LQ$

$\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8} = \lambda$

$L(2\lambda + 1, -3\lambda - 1, 8\lambda - 10)$

direction ratio of PL $(2\lambda, -3\lambda - 1, 8\lambda - 10)$

PL and AB are perpendicular lines

$2(2\lambda) - 3(-3\lambda - 1) + 8(8\lambda - 10) = 0$

$\Rightarrow 77\lambda - 77 = 0$

$\Rightarrow \lambda = 1$

$L(3, -4, -2)$

L is the mid point of PQ

$Q(x_1, y_1, z_1)$

Then $\frac{x_1+1}{2} = 3 \quad \Rightarrow \quad x_1 = 5$

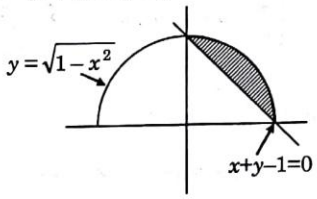
$\frac{y_1+0}{2} = -4 \quad \Rightarrow \quad y_1 = -8$

and $\frac{z_1+0}{2} = -2 \quad \Rightarrow \quad z_1 = -4$

reflection point of P is $(5, -8, -4)$

82.[A] Point (α, α) will lie is shaded region

it $\alpha^2 + \alpha^2 - 1 < 0$



$\Rightarrow 2\alpha^2 - 1 < 0$

$\Rightarrow -\frac{1}{\sqrt{2}} < \alpha < \frac{1}{\sqrt{2}} \quad ...(1)$

and $\alpha + \alpha > 1 \quad \Rightarrow \alpha > \frac{1}{2} \quad ...(2)$

$\therefore$ common solution of (1) and (2) is :

$\frac{1}{2} < \alpha < \frac{1}{\sqrt{2}}$

83.[C] $\because \quad \frac{dy}{dx} - \frac{\tan(1/x)}{x^2} y = -\frac{\sec(1/x)}{x^2} \quad ...(1)$

$\because$ I.F. $= e^{-\int \frac{\tan(1/x)}{x^2} dx} = e^{\ln \sec(1/x)} = \sec(1/x)$

$\therefore \quad y \sec(1/x) = -\int \frac{\sec^2(1/x)}{x^2} dx$

$\Rightarrow \quad y \sec(1/x) = \tan(1/x) + c \quad ...(2)$

If $x \to \infty; y \to -1$

$\Rightarrow \quad (-1)(1) = 0 + c$

$\Rightarrow \quad c = -1$ put in (2)

$y = \sin(1/x) - \cos(1/x)$

84.[B] $\because \quad \cot^{-1}(7) + \cot^{-1}(8) + \cot^{-1}(18) = \theta$

$\Rightarrow \quad \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{8}\right) + \tan^{-1}\left(\frac{1}{18}\right) = \theta$

$\Rightarrow \quad \tan^{-1}\left(\frac{\frac{1}{7}+\frac{1}{8}}{1+\frac{1}{7}\cdot\frac{1}{8}}\right) + \tan^{-1}\left(\frac{1}{18}\right) = \theta$

$\Rightarrow \quad \tan^{-1}\left(\frac{3}{11}\right) + \tan^{-1}\left(\frac{1}{18}\right) = \theta$

$\Rightarrow \quad \tan^{-1}\left(\frac{65}{195}\right) = \theta$

$\Rightarrow \quad \tan^{-1}\left(\frac{1}{3}\right) = \theta$

$\Rightarrow \quad \cot^{-1}(3) = \theta$

$\Rightarrow \quad \cot\theta = 3$

85.[C] $\because \quad A\,(adj\,A) = |A|\, I_n$

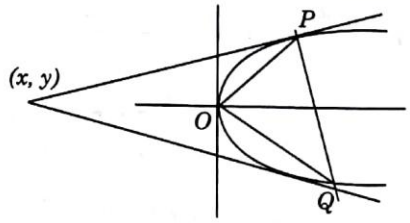
$\therefore \quad |AB + KI_n| = ||A|\, I_n + KI_n|$

$= (|A| + K)^n |I_n|$

$= (|A| + K)^n$

86.[A] Let $y = mx + c$ is the variable chord which is subtending right angle at the vertex of parabola hence equation of pair of straight lines OP and OQ can be given by making a homogeneous second degree equation with the help of parabola and chord as follows

$y^2 - 4ax\left(\frac{y - mx}{c}\right) = 0$



for subtend 90° at vertex $1 + \frac{4am}{c} = 0$

$\Rightarrow c = -4am$

$\Rightarrow$ equation of chord is

$y = m(x - 4a)$

which is always passing through $(4a, 0)$

Let point of intersection of tangents at the extremities is (x_1, y_1)

hence equation of chord of contact is

$yy_1 = 2a(x + x_1)$

which is passing through $(4a, 0)$

$\Rightarrow x_1 + 4a = 0$

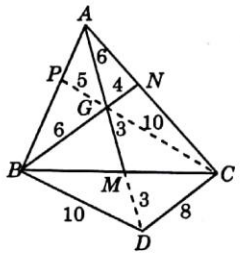
$\Rightarrow x + 4a = 0$ is the required locus.

87.[C] Produce the median AM to D such that $GM = MD$

and join to B and C.

Now $GBDC$ is a parallelogram. Note that the sides of the ΔGDC are 6, 8, 10

$\Rightarrow \angle GDC = 90°$



$$\left.\begin{aligned} \text{Area of } \Delta ADC &= \frac{12.8}{2} = 48 \\ \text{Area of } \Delta MDC &= \frac{3.8}{2} = 12 \end{aligned}\right]$$

$\Rightarrow$ Area of $\Delta AMC = 36$

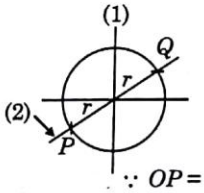
$\Rightarrow$ Area of $\Delta ABC = 72$ cm²]

88.[C] $x^2 + y^2 + xy - 3 = 0$ ...(1)

$y = \frac{x}{\sqrt{3}}$ ...(2)

$\because$ centre of ellipse is (0, 0) and (2) also passes through (0, 0)

$\therefore$ chord will be bisect at (0, 0).



$\because OP = OQ = r$

$\because$ equation PQ is $\frac{x-0}{\cos\frac{\pi}{6}} = \frac{y-0}{\sin\frac{\pi}{6}} = \pm r.$

$\therefore \left(\frac{r\sqrt{3}}{2}, \frac{r}{2}\right)$ lies on (1)

$\Rightarrow \frac{3r^2}{4} + \frac{r^2}{4} + \frac{r^2\sqrt{3}}{4} - 3 = 0$

$\Rightarrow r^2 = \frac{3 \times 4}{(4 + \sqrt{3})} \Rightarrow r^2 = \frac{12}{4 + \sqrt{3}}$

$\therefore |OP||OQ| = \frac{12}{4 + \sqrt{3}}$

89.[B] $\left.\frac{dy}{dx}\right]_{x=0} = k^2 \Rightarrow \tan\psi = k^2 \Rightarrow \cot\left(\frac{\pi}{2} - \Psi\right) = k^2$

$\Rightarrow \left(\frac{\pi}{2} - \Psi\right) = \cot^{-1} k^2 = \sin^{-1} \frac{1}{\sqrt{1 + k^4}} \Rightarrow B$

90.[B] We have, $\tan 3x = \tan 5x$

$\Rightarrow 5x = n\pi + 3x, n \in Z \Rightarrow x = \frac{n\pi}{2}, n \in Z$

If n is odd, then $x = \frac{n\pi}{2}$ gives extraneous solutions. Thus, the solution of the given equation will be given by $x = \frac{n\pi}{2}$, where n is even, say $n = 2m$, $m \in Z$. Hence the required solution is $x = m\pi$, $m \in Z$.

PHYSICS

91.[D] Although the problem asks us to compare angular momenta of the two dumbbells, $L = I\omega$, and ω is identical for both dumbbells. Therefore, this is really a problem asking us to compare the moments of inertia I

$I_1 = \sum r^2 m$

$I_1 = \left(\frac{1}{2}d\right)^2 m + \left(\frac{1}{2}d\right)^2 m = \frac{d^2 m}{2}$

Now let's calculate I_2,

$I_2 = \sum r^2 m$

$I_2 = (d)^2 2m + (d)^2 2m$

$I_2 = 2d^2 2m = 4d^2 m$

$I_2 = 8\left(\frac{d^2 m}{2}\right) = 8I_1$

Because the moment of inertia I_2 is 8 times I_1, the angular momentum L_2 is $8L_1$ as well.

92.[B] As intensity decrease by 75% i.e. intensity is 25% of max intensity

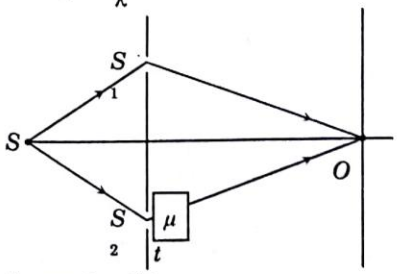
i.e. Iat center of screen $= \frac{4I_0}{4} = I_0$

$I = I_0 + I_0 + 2\sqrt{I_0}\sqrt{I_0}\cos\phi$

$\frac{4I_0}{4} = 2I_0 + 2I_0\cos\phi$

$\therefore \cos\phi = -\frac{1}{2} \Rightarrow \phi = \frac{2\pi}{3}, \frac{4\pi}{3}$.....

and $\phi = \frac{2\pi}{\lambda}\Delta x$



$\Delta x_{at\ O} = (\mu - 1)t$

$\phi = \frac{2\pi}{\lambda}(\mu - 1)t$

$\phi = \frac{4\pi}{3}$

$\frac{4\pi}{3} = \frac{2\pi}{\lambda}(\mu - 1)t$

Put $t = \lambda$

$\frac{2}{3} = \left(\frac{\mu - 1}{\lambda}\right)\lambda$

$\mu = \frac{5}{3}$

93.[C] $dU = \frac{dW}{2}$

by 1st law $\rightarrow dQ = 3dU = 3nC_v dT$

molar heat capacity $C = \frac{dQ}{ndT} = 3C_V$

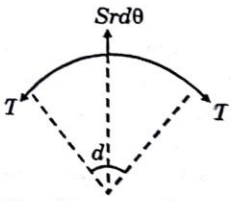
given $C = \frac{15R}{2}$

$\therefore C_V = \frac{5}{2}R$

$\therefore$ degree of freedom = 5

so gas is diatomic.

94.[B]



Consider an element of wire forming angle θ at the centre

$2T\sin\frac{d\theta}{2} = 2 \times [S \times R \times d\theta]$

$\therefore T = 2SR$

$Y = \frac{Fl}{A\Delta l}$

$\frac{YA \times \Delta R}{R} = 2SR$

$\Delta R = \frac{2SR^2}{YA}$

95.[C] $e = \frac{LdI}{dt} \Rightarrow e \propto L$ {as $\frac{di}{dt}$ is same for both coil}

$\frac{e_1}{e_2} = \frac{L_1}{L_2}$

power in both coil is same

$\therefore$ Power $= e_1 I_1 = e_2 I_2 \Rightarrow \frac{I_1}{I_2} = \frac{L_2}{L_1}$

96.[D] $e = Bv(2R)$ and Q is at high potential

97.[A] The weight of a floating body is equal to the weight of the displaced fluid. If V and v represent the total volume of the piece of granite and volume of granite in water respectively, we have

$V\rho g = v\rho_1 g + (V - v)\rho_2 g$

or $v(\rho_1 - p_2) = V(\rho - \rho_2)$

Therefore, $v/V = (\rho - \rho_2)/(\rho_1 - \rho_2)/(\rho_1 - \rho_2)$

The ratio required in the question is $v/(V - v)$ and is given by

$v/(V - v) = (\rho - \rho_2)/[(\rho_1 - \rho_2) - (\rho - \rho_2)]$

Or, $v/(V - v) = (\rho - \rho_2)/(\rho_1 - \rho) = (\rho_2 - \rho)/(\rho - \rho_1)$

98.[D] For small angles of θ (typically less than 15°), the frequency of oscillation for a simple pendulum is approximately.

$$f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{g}{\ell}}$$

For increasingly large value of θ, however, the acceleration no longer varies linearly with displacement. Thus, for larger angles, the frequency f will be a affected by the angle of release θ, as well as by the length of the pendulum.

99.[A] Let the first truck move to the right and the second to the left. Let us take the rightward direction as positive. In the horizontal direction, friction being absent, no external force is acting on the system. Hence momentum is conserved.

The momentum carried away by a sack thrown from the first is mv_1. the momentum brought in by the second sack to the first is $m(-v_2)$.

∴ By the law of conservation of momentum of (truck + sacks of rice)

$(M + m)\, v_1 - mv_1 + m(-v_2) = (M + m)\, v_1'$

where v_1' is the new velocity of truck 1.

$\therefore Mv_1 - mv_2 = (M + m)\, v_1'$

$$\therefore v_1' = \frac{M}{M+m} v_1 - \frac{m}{M+m} v_2$$

$$= \frac{200}{250}.50 - \frac{50}{250}.200 = 0$$

Similarly considering conservation of momentum of the second (truck + sacks of rice), we get for the second truck.

$$v_2' = -\left[\frac{M}{M+m} v_2 - \frac{m}{M+m}.v_1\right]$$

$$= -\left[\frac{200}{250} \times 200 - \frac{50}{250} \times 50\right] = -150 \text{ m/s.}$$

100.[C] $\vec{v} = a\hat{i} + bx\hat{j}$

$v_x = a$ and $v_y = bx$

$$\frac{dx}{dt} = a$$

$\therefore x = at + C$

Since $x = 0$ at $t = 0$, $C = 0$

$\therefore x = at$

$$\frac{dy}{dx} = bx = abt \qquad \text{.....(1)}$$

$$\therefore y = \frac{abt^2}{2} + C$$

$$\therefore y = \frac{abt^2}{2}$$

as $y = 0$ at $t = 0$ .....(2)

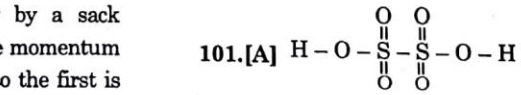
From equation (1) and (2),

$$y = \frac{abt^2}{2} = \frac{b}{2a}x^2$$

Hence the trajectory is a parabola symmetrical about the y-axis.

CHEMISTRY

101.[A]



In H_2SO_5 the oxidation number of O is +6 as two O are having peroxide bond.

102.[B] $E_{Zn^{2+}|Zn} = E^{\circ}_{Zn^{2+}|Zn} + \frac{0.059}{2}\log[Zn^{+2}]$

Comparing with $y = mx + c$, graph between $E_{Zn^{2+}|Zn}$ and log $[Zn^{2+}]$ is a straight line with positive slope and positive intercept.

103.[C] $K = Ae^{-\frac{Ea}{RT}}$

$$\text{Log } K = \log A - \frac{E_a}{2.303R} \times \frac{1}{T}$$

$$\text{Slope} = \tan\theta = \left[-\frac{1}{2.303}\right] = -\frac{E_a}{2.303R}$$

So, $E_a = R = 2$ cal/mol

104.[D] In (B) option component B is more volatile where as in (D) option A is more volatile.

105.[B] I : As all are weak field ligands therefore all will have same number of unpaired electrons as in central metal ion.

II : V.B.T. does not give any interpretation about the relative thermodynamic stabilities of various complexes. This is one of the limitation of V.B.T.

III : Is correct statement.

106.[B] $\Delta T_b = i K_b .m$

$$\text{Given molality} = \frac{1\times1000}{250} = 4\text{m},$$

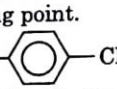
$6.4 = i \times 2 \times 4$ or $i = 0.8$

For dimerisation

$$i = 1 - \frac{\beta}{2} \Rightarrow 0.8 - 1 = \frac{-\beta}{2}$$

or $\beta = 0.4 \Rightarrow 40\%$

107.[D] S_1 : Dipole moment of cis-but-2-ene is higher than trans, hence cis has high boiling point.

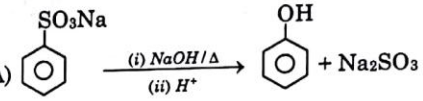
S_2 :  has equal and opposite dipoles, hence it has zero dipole moment.

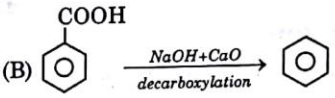
S_3 : In cycloalkenes cis isomers is more stable than trans for eight to twelve membered rings.

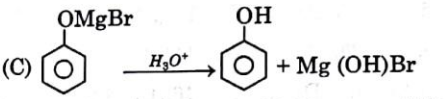
S_4 : Dipole moment of cis-1, 2-dibromoethene is higher than the trans, hence cis has more solubility.

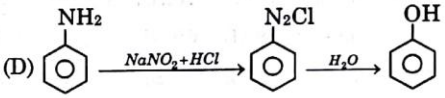
108.[D] It contains no C = C bond, C = O bond & acidic H.

109.[D] In the formation of osazone C–1 and C–2 react with phenyl hydrazing to form phenyl hydrazone. If C–3, C–4, C–5 have same configuration the carbohydrates will form same osazone even if they differ in configuration at C–1 or C–2.

110.[B] (A) 

(B) 

(C) 

(D) 

BIOLOGY

111.[B] testes to epididymis

112.[B] The pressure of blood exerted on the walls of arteries and veins

113.[A] I-bone marrow & thymus;
II-diacetylmorphine;
III-benign;
IV-B, T

114.[C] IgD

115.[C] Ovum covering of the female

116.[A] IUDs

117.[A] Biogenetic law of Haeckel

118.[D] Pectoral fins of fishes and forelimbs of horse

119.[B] Hens

120.[D] A → p; B → r; C → q

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SX

Practice Set-3

Hints & Solutions

Answer key

1.(C)	2.(A)	3.(D)	4.(A)	5.(C)	6.(B)	7.(C)	8.(D)	9.(B)	10.(C)	11.(C)	12.(C)	13.(C)	14.(C)	
15.(C)	16.(A)	17.(D)	18.(A)	19.(B)	20.(C)	21.(A)	22.(D)	23.(B)	24.(D)	25.(D)	26.(C)	27.(A)	28.(B)	
29.(A)	30.(C)	31.(C)	32.(C)	33.(D)	34.(B)	35.(A)	36.(D)	37.(B)	38.(A)	39.(A)	40.(B)	41.(D)	42.(B)	
43.(A)	44.(D)	45.(A)	46.(B)	47.(C)	48.(D)	49.(D)	50.(C)	51.(D)	52.(C)	53.(A)	54.(C)	55.(A)	56.(B)	
57.(A)	58.(D)	59.(B)	60.(B)	61.(B)	62.(B)	63.(C)	64.(B)	65.(B)	66.(C)	67.(A)	68.(C)	69.(B)	70.(B)	
71.(A)	72.(D)	73.(B)	74.(B)	75.(A)	76.(A)	77.(B)	78.(C)	79.(B)	80.(C)	81.(D)	82.(A)	83.(B)	84.(A)	
85.(C)	86.(C)	87.(B)	88.(A)	89.(B)	90.(A)	91.(D)	92.(A)	93.(A)	94.(A)	95.(D)	96.(A)	97.(A)	98.(D)	
99.(C)	100.(D)	101.(B)	102.(C)	103.(D)	104.(C)	105.(D)	106.(D)	107.(C)	108.(A)	109.(B)	110.(C)	111.(A)	112.(A)	
113.(C)	114.(A)	115.(A)	116.(B)	117.(D)	118.(A)	119.(C)	120.(D)							

PART-I [One Mark Questions]

MATHEMATICS

1.[C] Since, $y = mx + \frac{1}{m}$

or $m^2h - mk + 1 = 0$,

we have $m_1 + m_2 = \frac{k}{h}$,

and $m_1m_2 = \frac{1}{h}$

Given, $\theta_1 + \theta_2 = \frac{\pi}{4}$

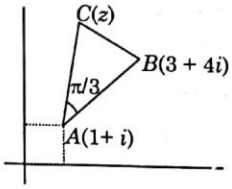
$\therefore \tan(\theta_1 + \theta_2) = \tan\frac{\pi}{4}$

$\Rightarrow \frac{m_1 + m_2}{1 - m_1m_2} = 1$

$\Rightarrow \frac{k}{h} = 1 - \frac{1}{h}$

$\Rightarrow y = x - 1 \Rightarrow x - y - 1 = 0$

2.[A]



$\frac{z-(1+i)}{AC} = \frac{(2+3i)}{AB}e^{i\pi/3}$

$\Rightarrow z - 1 - i = 2(2 + 3i)\left(\frac{1}{2} + \frac{\sqrt{3}}{2}i\right)$

$\Rightarrow z - 1 - i = (2 + 3i)(1 + \sqrt{3}i)$

$\Rightarrow z = 3 + 4i + i\sqrt{3}(2 + 3i)$

3.[D] Let n_1 and n_2 be the number of observations in two groups having means $\overline{X}_1$ and $\overline{X}_2$ respectively. Then

$\overline{X} = \frac{n_1\overline{X}_1 + n_2\overline{X}_2}{n_1 + n_2}$

Now, $\overline{X} - \overline{X}_1 = \frac{n_1\overline{X}_1 + n_2\overline{X}_2}{n_1+n_2} - \overline{X}_1$

$= \frac{n_2(\overline{X}_2 - \overline{X}_1)}{n_1+n_2} > 0 \ [\because \overline{X}_2 > \overline{X}_1]$

$\Rightarrow \overline{X} > \overline{X}_1 \quad \ldots (1)$

And, $\overline{X} - \overline{X}_2 = \frac{n(\overline{X}_1 - \overline{X}_2)}{n_1+n_2} < 0 \ [\because \overline{X}_2 > \overline{X}_1]$

$\Rightarrow \overline{X} < \overline{X}_2 \quad \ldots (2)$

From (1) and (2)

$\overline{X}_1 < \overline{X} < \overline{X}_2$.

4.[A] $P(A^C \cap B^C \cap C^C) = 1 - P(A) - P(B) - P(C) + P(A \cap B) + P(B \cap C) + P(C \cap A) - P(A \cap B \cap C)$

$P(A^C \cap B^C \cap C^C)_{max} = 1 - P(A) - P(B) - P(C) + P(A \cap B) + P(B \cap C) + P(C \cap A) = 0.31$

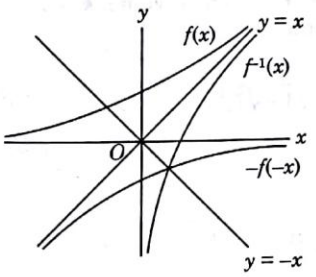
5.[C] $-1 \le x^2 - 3x + 3 \le 1$

$\Rightarrow x^2 - 3x + 4 \ge 0$ and $x^2 - 3x + 2 \le 0$

$\Rightarrow x \in [1, 2]$

$f'(x) = \frac{2x-3}{\sqrt{1-(x^2-3x+3)^2}} \ge 0 \Rightarrow x \ge \frac{3}{2}$

6.[B]



7.[C] Chord of contact w.r.t. (–4, 2) is

$-\frac{4x}{a^2} - \frac{2y}{b^2} = 1$

Slope $m_1 = \frac{-2b^2}{a^2} \quad \ldots(1)$

Chord of contact w.r.t. (2, 1) is

$\frac{2x}{a^2} - \frac{y}{b^2} = 1$

Slope $m_2 = \frac{2b^2}{a^2}$

$\therefore m_1 m_2 = -1$

$\frac{4b^4}{a^4} = 1$

$2b^2 = a^2$

$\Rightarrow 2a^2(e^2 - 1) = a^2 \Rightarrow e = \sqrt{\frac{3}{2}}$

8.[D] $f(x) = 2e^x - c\ell n\, x$

$f'(x) = 2e^x - \frac{c}{x} \ge 0 \Rightarrow \frac{2xe^x - c}{x} \ge 0$

$\Rightarrow c \le 2xe^x \Rightarrow c \le 0$

9.[B] $\frac{a+2c}{b+3d} + \frac{4}{3} = 0$

$\Leftrightarrow 3a + 4b + 6c + 12d = 0$

$\Leftrightarrow \frac{1}{4}a + \frac{b}{3} + \frac{c}{2} + d = 0$

Consider

$f(x) = \frac{ax^4}{4} + \frac{bx^3}{3} + \frac{cx^2}{2} + dx$

Then, $f(0) = 0 = f(1)$

$\therefore f(x)$ satisfies the conditions of Rolle's theorem in [0, 1].

Hence, $f'(x) = 0$ has at least one solution in (0, 1).

10.[C] $\alpha + \beta = 1154$ and $\alpha\beta = 1$

$(\sqrt{\alpha} + \sqrt{\beta})^2 = \alpha + \beta + 2\sqrt{\alpha\beta}$

$= 1154 + 2 = 1156 = (34)^2$

$\sqrt{\alpha} + \sqrt{\beta} = 34$

Again, $(\alpha^{1/4} + \beta^{1/4})^2 = \sqrt{\alpha} + \sqrt{\beta} + 2(\alpha\beta)^{1/4}$

$= 34 + 2 = 36$

$\alpha^{1/4} + \beta^{1/4} = 6$

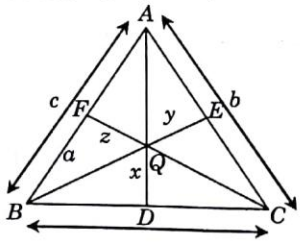
11.[C] For $n = 2 \Rightarrow (A^{-1}BA)(A^{-1}BA) = A^{-1}B^2A$

$(A^{-1}BA)^3 = (A^{-1}BA)^2 (A^{-1}BA) = (A^{-1}B^2A)(A^{-1}BA)$

$= A^{-1}B^3A$ and so on thus $(A^{-1}BA)^n$

$= A^{-1}B^nA$

12.[C] Given $a = b = c$



Area of triangle $ABC = \frac{\sqrt{3}}{4}a^2$ = area of triangle ABQ + area of triangle BQC + area of triangle CQA

$$\frac{\sqrt{3}}{4}a^2 = \frac{1}{2}ax + \frac{1}{2}by + \frac{1}{2}cz$$

$$\frac{\sqrt{3}}{2}a = (x + y + z) = P$$

13.[C] We have, $\frac{x^2 + 9y^2}{2} \geq 3xy$,

$$\frac{x^2 + 25z^2}{2} \geq 5xz, \quad \frac{9y^2 + 25z^2}{2} \geq 15yz$$

$$\Rightarrow x^2 + 9y^2 + 25z^2 \geq xyz\left(\frac{15}{x} + \frac{5}{y} + \frac{3}{z}\right)$$

Here, the equality sign holds if and only if;
$x = 3y = 5z$
$\Rightarrow x, y, z$ are in H.P.

14.[C] $1 + 9(\vec{a}.\vec{b})^2 - 6(\vec{a}.\vec{b}) + 4|\vec{a}|^2 + |\vec{b}|^2 + 9|\vec{a} \times \vec{b}|^2 + 4(\vec{a}.\vec{b}) = 47$

$$\Rightarrow 1 + 4 + 4 + 36 - 4\cos\theta = 47$$

$$\Rightarrow \cos\theta = -\frac{1}{2}$$

$\Rightarrow$ Angle between $\vec{a}$ & $\vec{b}$ is $\frac{2\pi}{3}$

15.[C] $a_1 = 1$

$$3a_{n+1} - 3a_n = 1$$

$$a_{n+1} = \frac{3a_n + 1}{3} = a_n + \frac{1}{3},$$

$$a_2 = a_1 + \frac{1}{3} = 1 + \frac{1}{3}$$

$$a_3 = a_2 + \frac{1}{3} = a_1 + \frac{1}{3} + \frac{1}{3} = 1 + \frac{2}{3}$$

$$a_4 = a_3 + \frac{1}{3} = 1 + \frac{2}{3} + \frac{1}{3} = 1 + \frac{3}{3}$$

....

....

$$a_{2002} = 1 + \frac{2001}{3} = 1 + 667 = 668$$

16.[A] Let $2^{-x} = t \quad \therefore t > 0$ .... (i)

$$\therefore \quad 2t^2 - 7t < 4$$

$$\Rightarrow \frac{-1}{2} < t < 4 \qquad \ldots \text{(ii)}$$

from (i) & (ii)

$0 < t < 4$

$0 < 2^{-x} < 4 \Rightarrow -2 < x < \infty \Rightarrow x \in (-2, \infty)$

17.[D] $(x + y + z)^2 = 144$

$$\therefore \quad \Sigma x^2 + 2\Sigma xy = 144$$

$$\Rightarrow \quad \Sigma xy = 24$$

Now $\frac{\Sigma xy}{xyz} = 36$

$$\Rightarrow \quad xyz = \frac{2}{3}$$

$$\therefore x^3 + y^3 + z^3 - 3xyz = (x + y + z)(\Sigma x^2 - \Sigma xy)$$

$$\therefore \quad \Sigma x^3 - 2 = 12(96 - 24)$$

$$\Rightarrow \quad \Sigma x^3 = 866$$

18.[A] $x^2 - (k - 2)x + k^2 = 0$

$x^2 + kx + 2k - 1 = 0$ should have both roots. common or each should have equal roots.

Case- (i) $\frac{1}{1} = \frac{-(k-2)}{k} = \frac{k^2}{2k-1}$

$\Rightarrow k = -k + 2$ and $2k - 1 = k^2$

$\Rightarrow k = 1$

Case- (ii) $(k-2)^2 - 4k^2 = 0$ and $k^2 - 4(2k-1) = 0$

$(3k - 2)(-k - 2) = 0$ and $k^2 - 8k + 4 = 0$

have no common value, $k = 1$ is the only solution.

19.[B] $\because (\sqrt{3} + \sqrt{7})^{17} = \sum_{r=0}^{17} {}^{17}C_r (\sqrt{3})^r (\sqrt{7})^{17-r}$

$$= \sum_{r=0}^{17} {}^{17}C_r 3^{\frac{r}{2}} 7^{\frac{17-r}{2}}$$

$\because$ Both $\frac{r}{2}$ & $\frac{17-r}{2}$ can't be integer at same so all term are irrational

$\therefore$ Total irrational terms are 18

$\therefore \quad k = 3$

20.[C] On (1, 2, 3) satisfies the plane $x - 2y + z = 0$ & also $(\hat{i} + 2\hat{j} + 3\hat{k}).(\hat{i} - 2\hat{j} + \hat{k}) = 0$

Since, the lines $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$ and $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ both satisfy (0, 0, 0) & (1, 2, 3), both are same

Given line is obviously parallel to the plane $x - 2y + z = 6$

PHYSICS

21.[A] Cond. Sphere is an equipotential surface.

22.[D] $P_{B_1+B_2} = 30$ W

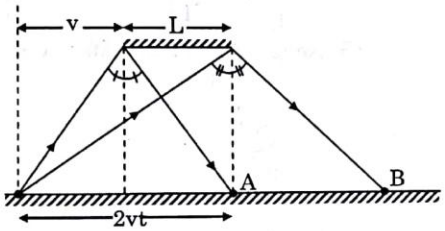
$P_{B_3} = 60$ W

$P_{B_4} = 60$ W

$$P_{B_5} = \frac{(200)^2}{\frac{400^2}{120}} = \frac{120}{4} = 30\text{W}$$

$P_{total} = 180$W

23.[B]



$v_A = \frac{d}{dt}(2vt) = 2v$; $v_B = \frac{d}{dt}(2vt + 2L) = 2v$

$\Rightarrow v_A = v_B$

$\therefore$ length of AB will remain same.

24.[D] $\text{Energy}_{\text{Released}}$ in xy joint

$$= (\text{C.V}).\text{V} - \frac{1}{2}\text{CV}^2 = \frac{1}{2}\text{CV}^2$$

$\text{Energy}_{\text{Released}}$ in xz joint

$$= (2\text{C.V}).\text{V} - \frac{1}{2}\text{CV}^2 = \frac{3}{2}\text{CV}^2$$

$\text{Total heat}_{\text{Released}} = 2\text{CV}^2$ which is 4 times energy store.

25.[D] $P_1 = P_2$

$$T_1 = T_2 \quad \Rightarrow \frac{V_1}{n_1} = \frac{V_2}{n_2} \Rightarrow \frac{2\pi - \alpha}{n_1} = \frac{\alpha}{n_2}$$

$\Rightarrow M_1(2\pi - \alpha) = M_2\,\alpha$

$$\text{or} \quad \alpha = \frac{2\pi M_1}{M_1 + M_2} = \frac{16\pi}{15}$$

26.[C] $k = \frac{2\pi}{\lambda} = 0.025\,\pi \Rightarrow \frac{\lambda}{2} = \frac{1}{0.025} = 40$ cm.

The shortest possible length will be

$$L_{min} = \frac{\lambda}{2} = 40 \text{ cm.}$$

27.[A] TTF

28.[B] ${}_zX^A \longrightarrow {}_{z-1}Y^A + e^+ + \nu$

$\downarrow$

$2\alpha + {}_{z-5}X^{A-B}$

Given $A - 8 = 224$.

& $Z - 5 = 89 \quad \Rightarrow A = 237,\ Z = 94.$

29.[A] It can be seen from the diagram that only the sphere B and sphere C repel. Hence they both must be of same type. According to the fact that at least two spheres are positively charged, therefore both spheres should be positively charged. Since attraction occurs for two remaining pairs it can be concluded that the sphere A is negatively charged.

30.[C] maximum energy in the inductor will be $3Q^2/2C$

31.[C] At path difference $\frac{\lambda}{6}$, phase difference is

$\frac{\pi}{3}$

$I = I_0 + I_0 + 2I_0 \cos\frac{\pi}{3} = 3\,I_0 \qquad I_{max} = 4I_0$

So the required ratio is $\frac{3I_0}{4I_0} = 0.75$

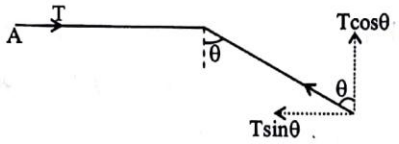
32.[C] Here direction of light is given by normal vector

$\vec{n} = \hat{i} + 2\hat{j} + 3\hat{k}$

$\therefore$ angle made by the $\vec{n}$ with y-axis is given by $\cos\beta = \frac{2}{\sqrt{1^2 + 2^2 + 3^3}} = \frac{2}{\sqrt{14}}$

33.[D] the motion must be uniform circular motion

34.[B]



$T \sin\theta < T$

$\therefore\ t_A < t_B$

35.[A] Let N denot the total no of nuclei. Initially

$N = N_u + N_s$. After a time T since the activity decreased to one third, number of unstable nuclei will also become one third. So after a time T, $N/2 = N_u/3 + N_s$. Solving the two equation we get $= N_s/N_u = 1/3$.

36.[D] Conservation of angular momentum

$$\Rightarrow \frac{\omega_0}{2}\left[(\mu t)R^2 + \frac{m_0R^2}{2}\right] = \frac{m_0R^2}{2}\omega_0$$

$$\Rightarrow t = \frac{m_0}{2\mu}$$

37.[B] B/S = F/area × length/F

= 1/length = wave number

38.[A] Energy Density $= \frac{1}{2}$ stress × strain

$$= \frac{1}{2}Y(\text{strain})^2 = 2880\ J/m^3$$

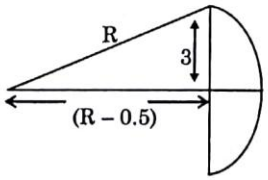
39.[A] $(\text{Range})_1 = (\text{Range})_2$

$$\sqrt{2g(\ell-0.1)}\sqrt{\frac{2\times0.1}{g}} = \sqrt{2g(\ell-0.2)}\sqrt{\frac{2\times0.2}{g}}$$

$\ell = 0.3$

40.[B] $R^2 = 9 + (R-0.5)^2$

$R = 9.25$ cm



$$\frac{1}{37} = (\mu-1)\left(\frac{1}{\infty}+\frac{1}{R}\right)$$

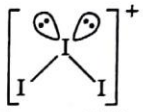
$$\Rightarrow \mu = 1.25 = \frac{c}{v}$$

$$v = \frac{3\times10^8}{1.25} = 2.4\times10^8\ m/s.$$

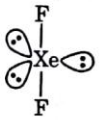
CHEMISTRY

41.[D] (A) $I_3^+ = \frac{[7+2-1]}{2} = sp^3$

Hybridisation with 2 lone pair

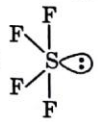


(B) XeF_2 sp^3d linear structure (3 lone pair + 2B.P.)

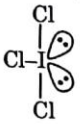


O=C=O has same shape

(C)



sp^3d 1 ℓ.p + 3 B.P = sea saw structure

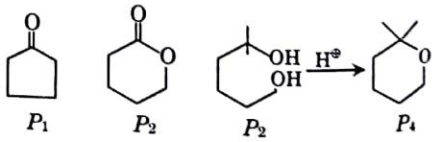


T shaped structure

$\therefore$ All are correct.

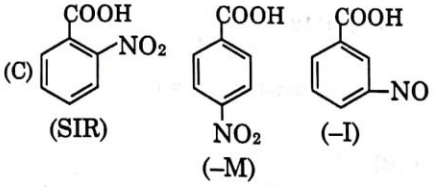
42.[B] Cellulose is Biopoly sacchared which is formed by polymerisation of D-glucose units through β–glycosidic linkage

43.[A]



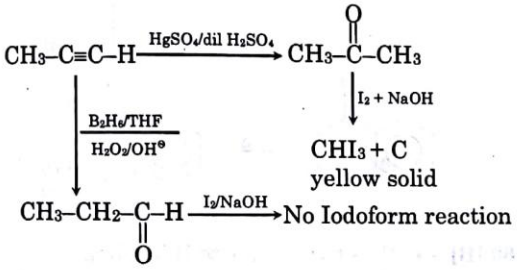
P_1 P_2 P_2 P_4

44.[D] (A) Overall withdrawing power of Cl is greater than F in conjugation.



(D) SiH_3 is better +I than $-CH_3$

45.[A]



46.[B] $\frac{\lambda_B}{\lambda_A} = \sqrt{\frac{m_A E_A}{m_B E_B}}$

$$\frac{E_A}{E_B} = \left(\frac{\lambda_B}{\lambda_A}\right)^2 \cdot \frac{m_B}{m_A}$$

$$= \left(\frac{5}{2}\right)^2 \cdot \frac{1}{2} = \frac{25}{4}$$

47.[C] $V_L = \frac{V_0}{273} t + V_0$

$$[V_t - V_0] = \frac{V_0}{273} t$$

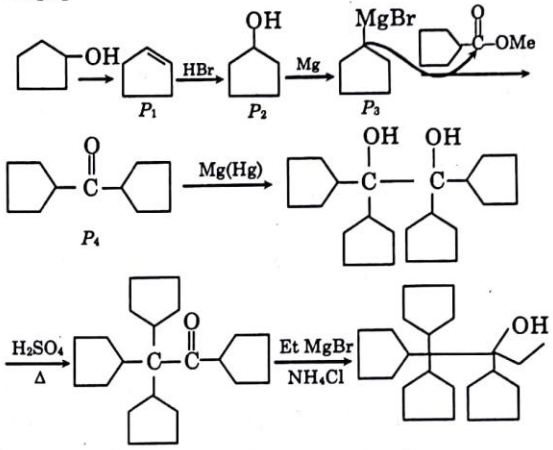
$$[V_t - V_0] \frac{273}{V_0} = t$$

$$\left[\frac{V_t}{V_0} - 1\right] 273 = t$$

$$\frac{273 V_t}{V_0} - 273 = t$$

t vs V_t slope $= \frac{273}{V_0}$

48.[D]



49.[D] $[Co(en)_3]^{3+}$ only show optical isomerism
$PtCl_2(NH_3)_2$ cis & trans platin
$[CoCl_2(NH_3)_4]^+$ cis trans
$[Co(NO_2)_3(NH_3)_3]$ facial & meridinial

50.[C] For a nth order reaction :

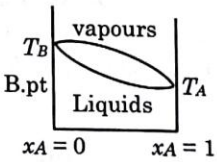
$$kt = \frac{1}{n-1}\left[\frac{1}{[A]^{n-1}} - \frac{1}{[A]_0^{n-1}}\right]$$

For 75% completion of reaction $[A] = \frac{[A]_0}{4}$

$$\Rightarrow t = \frac{1}{k(n-1)}\left[\frac{4^{n-1}-1}{[A]_0^{n-1}}\right]$$

$$= \frac{1}{k(n-1)}\left(\frac{2^{2n-2}-1}{a^{n-1}}\right)$$

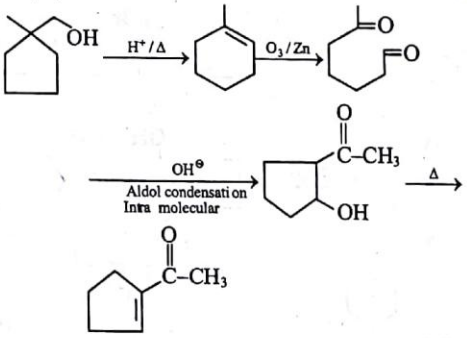
51.[D]



→ Liquid which is more volatile have less boiling point

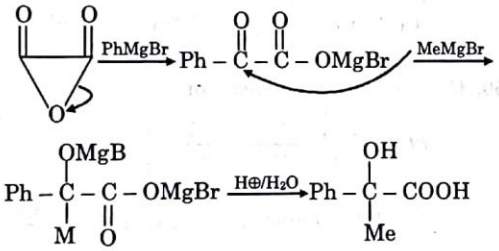
→ At higher temperature vapour phase exist in place of liquid

52.[C]



53.[A] Trans cyclo octene is chiral without chiral centre it is special case of optical isomerism. In other example POS is present

54.[C]

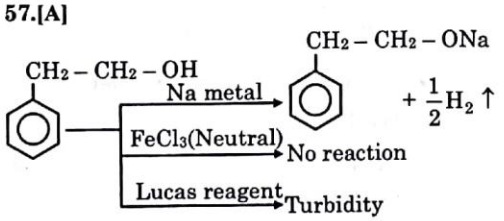


55.[A] $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g); \Delta H < 0$

By Le-Chatelier principle, higher pressure and lower temperature favour the forward reaction, i.e., higher % of NH_3.

56.[B] Smaller is the 'gold number of protective colloid, greater is its protective power. Gold no. is the parameter which is used to measure protective power of Lyophillic colloids

57.[A]



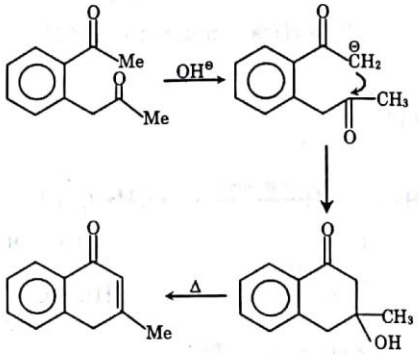
–ve $FeCl_3$ means it cannot be phenol

58.[D] $\boxed{K = \frac{1}{R} \times \frac{\ell}{a}}$

$0.0112 = \frac{1}{55} \times \frac{\ell}{a}$

Cell constant $\frac{\ell}{a} = 0.0112 \times 55 = 0.616$

59.[B]



60.[B] → (I) is correct due to H bonding
→ (II) In cycloalkene cis isomer is stable upto 8-10 membering.
→ (III) trans more stable than cis.
→ (IV) Due to H bond Gauche more stable
→ (V) Generally equatorial conformer more stable than axial conformer

BIOLOGY

61.[B] Non-infectious and increased secretions of IgE

62.[B] Methemoglobinemia

63.[C] the pink flower & white flower ratio in 1 : 1

64.[B] Secondary structure

65.[B] 0.1 – 20 kb

66.[C] Urea and uric acid

67.[A] Avena curvature test

68.[C] GA

69.[B] Cyclic AMP

70.[B] On cell surface

71.[A] The volume of urine will increase

72.[D] Carbon dioxide get reduced and water get oxidized

73.[B] 12 pairs

74.[B] Interphase

75.[A] Marasmus

76.[A] Grass-Grasshopper-Frog-Snake-Hawk

77.[B] Variable region of both heavy and light chain

78.[C] Natural resistance

79.[B] Small pox

80.[C] RNA → DNA → RNA → proteins

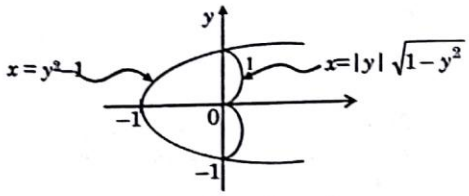
PART-II [Two Marks Questions]

MATHEMATICS

81.[D] $\because\ x = y^2 - 1,\ x = |y|\sqrt{1-y^2}$

$\therefore$ Required area

$$= 2\left[\int_0^1 y\sqrt{1-y^2}\,dy + \left|\int_0^1 (y^2-1)dy\right|\right]$$



$$= 2\left[\frac{1}{3} + \left|-\frac{2}{3}\right|\right] = 2\left[\frac{1}{3} + \frac{2}{3}\right] = 2$$

82.[A] 2

83.[B] Let $D = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$

$$= a_{11}(a_{22}a_{33} - a_{32}a_{23}) + a_{12}(a_{31}a_{23} - a_{21}a_{33}) + a_{13}(a_{21}a_{32} - a_{31}a_{22})$$

for maximum value we have to assign maximum value to the +ve term & minimum value to –ve term which is possible if three elements will become zero of different row & different column.

$\therefore$ i.e. $a_{13} = a_{21} = a_{32} = 0$ & $a_{11} = a_{32} = a_{33} = a_{12}$

$\therefore\ D_{max} = 2 - 0 = 2$

84.[A] $f(x) = \int_1^x \frac{xf(x)+1}{x^2}\,dx$

$$f'(x) = \frac{xf(x)+1}{x^2} = \frac{1}{x}f(x) + \frac{1}{x^2}$$

i.e. $f'(x) - \frac{1}{x}f(x) = \frac{1}{x^2}$

Which is linear differential equation on solving it, we get

$$\therefore\ \frac{1}{x}f(x) = \int \frac{1}{x^3}dx + c = -\frac{1}{2x^2} + c$$

i.e. $f(x) = -\frac{1}{2x} + cx \quad \frac{3}{4} = f(2) = -\frac{1}{4} + 2c$

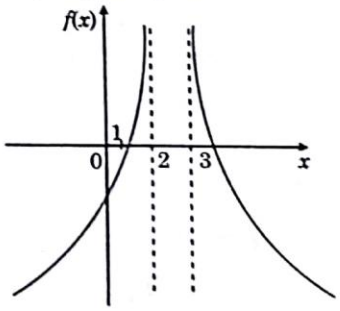
$$\Rightarrow\ c = \frac{1}{2}$$

$$f'(x) = \frac{1}{2x^2} + c \quad \therefore f'(1) = \frac{1}{2} + \frac{1}{2} = 1$$

85.[C] $\because\ f(x) = \log_{0.5}(x^2 - 5x + 6)$

$\Rightarrow\ f(x)$ will be defined if $x^2 - 5x + 6 > 0$

$\Rightarrow\ (x-2)(x-3) > 0$



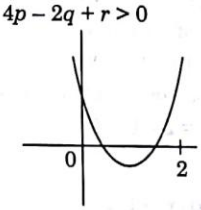
from graph of f(x) we can say that it will be a many-one and onto function.

86.[C] 0

87.[B] $f(1) = p - q + r = -1$ ...(i)

$f(0) = r > 0$ ...(ii)

$f(2) = 4p - 2q + r > 0$ ...(iii)



(ii) + (iii) $\Rightarrow$ $4p - 2q + 2r > 0$

$2p - q + r > 0$

$p + (p - q + r) > 0$ [using (i)]

$p - 1 > 0 \quad \Rightarrow p > 1$

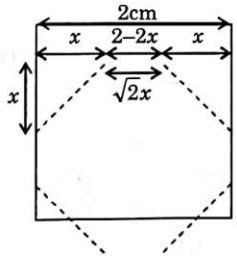
$\therefore \quad p = 2 \quad (\because p \in N)$

88.[A] Let x be the length of cutted portion

than $2 - 2x = \sqrt{2}\,x$

$x(2 + \sqrt{2}) = 2$

$$x = \frac{2}{\sqrt{2}(\sqrt{2}+1)} = \frac{\sqrt{2}}{1} \times \left(\sqrt{2}-1\right)$$



Area of octagon = Area of square – Area of 4 Δ

$$= 2 \times 2 - 4 \times \frac{1}{2} \cdot x^2$$

$$= 4 - \frac{4 \times 1}{2} \cdot \left[\sqrt{2}(\sqrt{2}-1)\right]^2$$

$$= 4 - 4(\sqrt{2}-1)^2$$

$$= 4\left[1 - 2 - 1 + 2\sqrt{2}\right)\Big]$$

$$= 8(\sqrt{2}-1)$$

89.[B] Line $y = \sqrt{3}\,x$ ...(1)

and curve

$x^3 + y^3 + 3xy + 5x^2 + 3y^2 + 4x + 5y - 1 = 0$ ...(2)

Solving (1) & (2) then

$\Rightarrow x^3 + 3\sqrt{3}\,x^3 + 3\sqrt{3}\,x^2 + 5x^2 + 9x^2 + 4x + 5\sqrt{3}\,x - 1 = 0$

Let roots x_1, x_2, x_3

then $x_1x_2x_3 = \dfrac{1}{3\sqrt{3}+1}$

Co-ordinates of A, B, C are

$(x_1, \sqrt{3}\,x_1), (x_2, \sqrt{3}\,x_2)$ and $(x_3, \sqrt{3}\,x_3)$ respectively.

then $OA.\ OB.\ OC = 8x_1\,x_2\,x_3$

$$= \frac{8}{3\sqrt{3}+1} = \frac{8(3\sqrt{3}-1)}{26} = \frac{4}{13}\,(3\sqrt{3}-1)$$

90.[A] $(\sin x - \sin 3x) + 2\sin 2x = 3$

$\Rightarrow -2\sin x \cos 2x + 2\sin 2x = 3$

$\Rightarrow 2\sin x \cos 2x - 2\sin 2x + 3 = 0$

$2\sin x \cos 2x - 2\sin 2x + (\sin^2 x + \cos^2 x) + (\sin^2 2x + \cos^2 2x) + 1 = 0$

$\Rightarrow (1 - \sin 2x)^2 + (\sin x + \cos 2x)^2 + \cos^2 x = 0$

$\Rightarrow$ No root

PHYSICS

91.[D] Based on the description of the particle's position at time $t = 0$, we know that the equation that describes the particle's x-coordinate as a function of time is

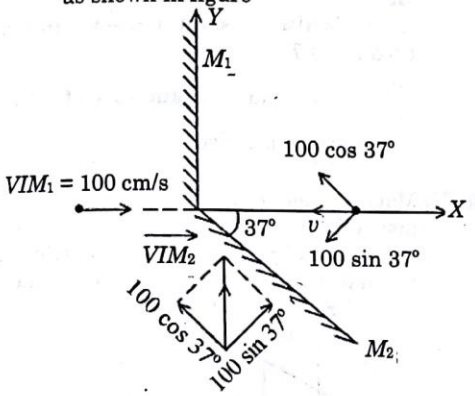
$x = A\cos(\omega t)$

To determine the x-component of the velocity, we take the time derivative of this function :

$$v_x = \frac{dx}{dt} = \frac{d}{dt} A\cos(\omega t) = -\omega A \sin(\omega t)$$

This is essentially a negative sine function, which matches the graph in answer 4. The problem may be solved conceptually, too, by considering the x-component of the rotating particle as a mass on a horizontally-stretched spring. The mass is released from a position $+A$ at time $t = 0$, at which point it begins to accelerate in the x-direction, beginning a simple harmonic oscillation. This motion is consistent with answer

92.[A] The components of various velocities are as shown in figure



$\overline{V}_{IM_2}$ is given by the vector sum of components of velocity of image with respect to M_2 along the normal and perpendicular to the normal

$\overline{V}_{IM_2} = [100 \sin^2 37°\,\hat{i} + 100 \sin 37° \cos 37°\,\hat{j}\,] +$

$[-100 \cos^2 37°\,\hat{i} + 100 \sin 37° \cos 37°\,\hat{j}\,]$

$= [-28\,\hat{i} + 96\,\hat{j}\,]$ cm/s

$\therefore\ \overline{V}_{IM_2, IM_1} = \overline{V}_{IM_2} - \overline{V}_{IM_1}$

$= (-128\mathrm{i} + 96\,\hat{j}\,)$ cm/s

93.[A] Pitch of the screw $= \frac{1}{12}$ cm

number of revolutions made to cover

3 cm $= \frac{3}{1/12} = 36$

spin frequency of the nut = 216 rpm

$= \frac{216}{60}$ Hz

angular speed $\omega = 2\pi\upsilon = 2\pi \times \frac{216}{60}$

$= 7.2\,\pi$ rad/s

$\omega = \frac{\theta}{t} \Rightarrow t = \frac{\theta}{\omega} = \frac{2\pi n}{\omega} = \frac{2\pi \times 36}{7.2\pi} = 10$ s

94.[A] A) In $\upsilon = u + at$ or $\upsilon = u - at$, if $|\ a\ |$ is doubled, the time t is halved.

hence, if t is the time for acceleration, then $\frac{t}{2}$ is the time taken for retarded motion/

$\therefore$ total time duration for travel is

$t + t + \frac{t}{2} = \frac{5t}{2}$

$\frac{5t}{2} = 5s$ (given) $\therefore\ t = 2s$

(i) Distance covered in accelerated motion

$S_1 = ut + \frac{1}{2}at^2$

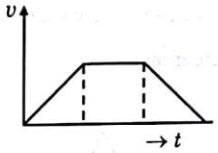
$= 0 \times t + \frac{1}{2} \times 3 \times 2^2 = 6$ m

(ii) Distance covered in uniform motion

$\upsilon = u + at = 0 + 3 \times 2 = 6\ \mathrm{ms}^{-1}$

$\therefore\ S_2 = \upsilon t = 6 \times 2 = 12$ m

(iii) Distance travelled in retarded motion



$S_3 = ut - \frac{1}{2}at^2$

$= 6 \times 1 - \frac{1}{2} \times 6 \times 1^2 = 3$m

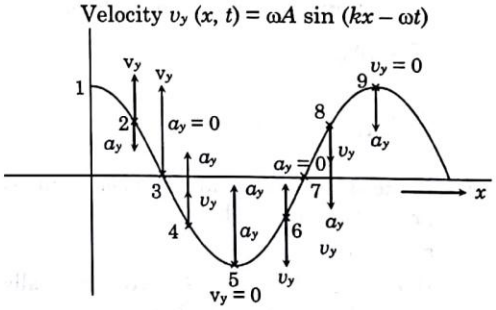
$\therefore$ total distance traversed

$S = S_1 + S_2 + S_3 = 6 + 12 + 3 = 21$ m

95.[D] Displacement $y(x, t) = A \cos(kx - \omega t)$

At $t = 0$, point 1 on the string has maximum displacement.

Velocity $\upsilon_y(x, t) = \omega A \sin(kx - \omega t)$



At $t = 0$, υ_y is maximum at $kx = \frac{\pi}{2}$

$\Rightarrow x = \frac{\pi\lambda}{2 \times 2\pi} = \frac{\lambda}{4}$ i.e., point 3 on the string.

Hence (A) is correct.

Acceleration $a_y(x, t) = \omega^2 A \cos(kx - \omega t)$

At $t = 0$, a_y is maximum downward acceleration

if $\cos kx = 1 \Rightarrow kx = 2\pi \Rightarrow x = \lambda$

i.e., point 9 on the string has maximum downward acceleration.

Hence (C) is correct.

At $t = 0$, $kx = -\pi$, $x = \frac{\lambda}{2}$ i.e., the string has maximum upward acceleration.
Hence (B) is correct
Velocity v_y is positive and acceleration a_y is negative when $0 < kx < \frac{\pi}{2}$

v_y is negative and a_y is positive $\pi < kx < \frac{3\pi}{2}$

v_y and a_y are positive when $\frac{\pi}{2} < kx < \pi$

v_y and a_y are negative when $\frac{3\pi}{2} < kx < \pi$

(D) is incorrect.

96.[A]

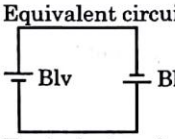
One satellite cover 120° angle for 360° 3 satellite are required.

97.[A] $f_c = 9\sqrt{N_0}$
where f_c is the frequency of wave signal, N_0 is electron density in Ionosphere

$\frac{f_c}{9} = \sqrt{N_0}$

$N = \frac{f_c^2}{81}$

98.[D] Induced emf due to motional emf is produced in both tube
$e = (\vec{v} \times \vec{B}).\vec{L}$
Here $\vec{v}$, $\vec{B}$ and $\vec{L}$ are mutually perpendicular to each other .
$\therefore e = BvL$
Equivalent circuit is shown

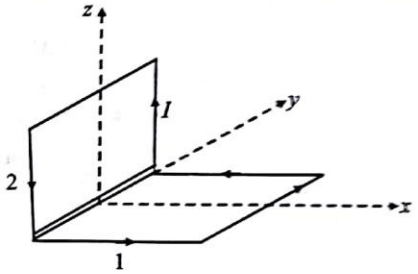


Equivalent emf
$e = Blv + Blv = 2Blv$

99.[C] $e = -L\frac{di}{dt}$
$e \propto$ Rate of change of current as $t = 0$ to $t = a$

$\frac{di}{dt}$ = + ve and constant
$\therefore$ emf is also constant and – ve in time $t = a$ to $t = T$
$\frac{di}{dt}$ = – ve and constant so emf is also constant and positive

100.[D] Magnetic field of any coil is in direction of magnetic moment of coil. this coil is in two plane xy and yz, so here we will split this coil in two separate coil in xy and yz plane



Magnetic moment of coil 1 is in $\hat{k}$
Magnetic moment of coil 2 is in $\hat{i}$
so $\vec{M}$ is in $\hat{i}$ and $\hat{k}$ so B must be in $\hat{i}$ and $\hat{k}$
only one option has B in $\hat{i}$ and $\hat{k}$
i.e. option (D) where $B = \frac{1}{\sqrt{2}}(\hat{i} + \hat{k})$

CHEMISTRY

101.[B]

	y = 115 mm	y = 150 mm	y = 120 mm	y = 105 mm
Initial pressure	65	105	y	185
Half life	290	x	670	820

Initial pressure of gas α Initial moles of gas in above question.
Half life α Initial pressure
So, it must be zero order reaction

$t_{1/2} = \frac{C_0}{2k} = \frac{P_0}{2k}$ $\quad 290 = \frac{65}{2k}$

$\Rightarrow k = \frac{65}{2 \times 290} = 0.112$ mm of Hg/sec

$x = \frac{105 \times 2 \times 290}{2 \times 65} = 468$ sec

$670 = \frac{y \times 2 \times 290}{2 \times 64} \Rightarrow y = 150$ mm of Hg

102.[C] $0 = (-0.151 - 0) - \frac{0.0591}{1}\log[H^+]$.

$0.0591 \times \log[H^+] = -0.151$

$pH = \frac{0.151}{0.0591} = \mathbf{2.56}$

103.[D] (A) Because of $3d^{10}$ configuration no $(n-1)d$ orbital is available for d^2sp^3 hybridisation and thus forms outer orbital complex. The complex is diamagnetic.

(B) Because of $3d^8$ configuration no $(n-1)d$ orbital is available for d^2sp^3 hybridisation and thus forms outer orbital complex. The complex is paramagnetic with two unpaired electrons.

(C) The complex is inner orbital complex but $3d^3$ configuration has three unpaired electrons with weak as well as with strong field ligand.

(D) In the diamagnetic octahedral complex, $[Co(NH_3)_6]^{3+}$, the cobalt ion is in +3 oxidation state.

104.[C] $\Delta T_f = i.m.K_f$

$\Delta T_f = i_1m_1K_f + i_2m_2K_f + i_3m_3K_f$

$= (m_1 + 2m_2 + m_3).K_f$

$$\Delta T_f = \frac{\frac{3}{60} + \frac{7.45 \times 2}{74.5} + \frac{9}{180}}{100} \times 1000 \times 1.86$$

$\Delta T_f = 3 \times 1.86 = 5.58$

T_f of solution $= 273 - 5.58 = 267.42$ K

105.[D] $A \rightarrow B$ (uncatalsed reaction)

$A \xrightarrow{catalyst} B$ (catalyst reaction)

$K = Ae^{-E_a/RT}$

$K_{cat.} = Ae^{-E_{a(cat.)}/RT}$

$$\frac{K_{cat}}{K} = e^{(E_a - E'_a)\times}\frac{1}{RT}$$

$$\frac{K_{cat}}{K} = e^{\frac{8.314\times10^3}{8.314\times300}} = e^{3.33} = 28 \text{ times}$$

106.[D] $Cu^+ + e^- \longrightarrow Cu$, $E^\circ = x_1$ Volt

$Cu^{2+} + 2e^- \longrightarrow Cu$, x_2 Volt

$Cu \longrightarrow Cu^+ e^- - x_1$ Volt

$Cu^{2+} + e^- \longrightarrow Cu^+ - 2 \times x_2 \times f + 1 \times x_1 \times f$

$= -1 \times E^\circ \times f$

$E^\circ = 2x_2 - x_1$

107.[C] Factual

108.[A]

$Cl{-}CH_2{-}CH_2{-}Cl$ (Ethylene chloride) $\xrightarrow[\Delta]{alc.\ KOH}$ $CH_2 = CH{-}Cl$

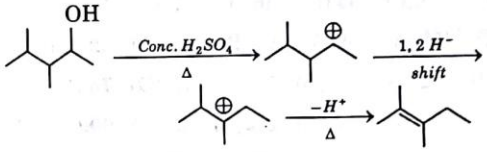
$CH_3{-}CHCl_2$ (Ethylidene chloride) $\xrightarrow[\Delta]{alc.\ KOH}$ $CH_2 = CH{-}Cl$

109.[B] X $= CH_3{-}CH(OH){-}CH_3$

Y $= CH_3{-}CH = CH_2$

Z $= CH_3{-}CH_2{-}CH_3OH$

110.[C]



BIOLOGY

111.[A] 2 molecule of NADPH and 3 molecule of ATP for its fixation

112.[A] Tapetum

113.[C] Law of segregation

114.[A] ZW and ZZ

115.[A] Deletion

116.[B] I, II, IV and V

117.[D] Modified pyrimidine

118.[A] DNA dependent RNA polymerase

119.[C] Adjacent to structural genes

120.[D] I, II, III and IV

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-4

Stream – SX

Hints & Solutions

Answer key

1.(A)	2.(C)	3.(A)	4.(C)	5.(B)	6.(A)	7.(C)	8.(C)	9.(C)	10.(A)	11.(B)	12.(A)	13.(B)	14.(C)
15.(D)	16.(A)	17.(C)	18.(D)	19.(B)	20.(A)	21.(B)	22.(A)	23.(D)	24.(D)	25.(B)	26.(B)	27.(A)	28.(D)
29.(C)	30.(D)	31.(D)	32.(B)	33.(B)	34.(C)	35.(A)	36.(C)	37.(D)	38.(C)	39.(B)	40.(A)	41.(A)	42.(A)
43.(C)	44.(C)	45.(B)	46.(A)	47.(C)	48.(D)	49.(C)	50.(D)	51.(D)	52.(B)	53.(A)	54.(B)	55.(B)	56.(C)
57.(D)	58.(A)	59.(A)	60.(B)	61.(A)	62.(D)	63.(B)	64.(A)	65.(A)	66.(C)	67.(C)	68.(B)	69.(A)	70.(A)
71.(B)	72.(A)	73.(B)	74.(B)	75.(D)	76.(D)	77.(B)	78.(A)	79.(B)	80.(A)	81.(A)	82.(B)	83.(B)	84.(D)
85.(C)	86.(C)	87.(A)	88.(A)	89.(B)	90.(D)	91.(D)	92.(D)	93.(B)	94.(B)	95.(C)	96.(A)	97.(A)	98.(A)
99.(D)	100.(B)	101.(D)	102.(C)	103.(D)	104.(C)	105.(D)	106.(B)	107.(B)	108.(D)	109.(D)	110.(C)	111.(A)	112.(D)
113.(C)	114.(B)	115.(A)	116.(A)	117.(C)	118.(B)	119.(A)	120.(C)						

PART-I [One Mark Questions]

MATHEMATICS

1.[A] Unit vector $\perp$ to plane ABC

$$= \frac{\overrightarrow{AB}\times\overrightarrow{AC}}{\left|\overrightarrow{AB}\times\overrightarrow{AC}\right|}$$

$$= \frac{1}{\left|\overrightarrow{AB}\times\overrightarrow{AC}\right|}\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 1 & 1 & -2\\ 2 & -1 & -1\end{vmatrix}$$

$$= \frac{\hat{i}(-1-2)-\hat{j}(-1+4)+\hat{k}(-1-2)}{\left|\overrightarrow{AB}\times\overrightarrow{AC}\right|}$$

$$= \frac{3\hat{i}-3\hat{j}-3\hat{k}}{\sqrt{27}} = \frac{(\hat{i}+\hat{j}+\hat{k})}{\sqrt{3}}$$

2.[C] As $\sin e \simeq \sin 2.71$ = positive value less than 1

$\log_{\sin e}\log_3\log_{0.2}x < 0$

$\Rightarrow \log_3\log_{0.2}x > 1$

$\Rightarrow \log_{0.2}x > 3$

$\Rightarrow x < (0.2)^3 \quad \{(0.2)^3 = .008 = \frac{1}{125}\}$

$\therefore$ solution set is $\left(0, \frac{1}{125}\right)$

3.[A] $(1+x^2)^2(1+x)^n$

$= (1+2x^2+x^4)({}^nC_0 + {}^nC_1x + {}^nC_2x^2 + ...)$

$= {}^nC_0 + {}^nC_1x + ({}^nC_2 + 2.\ {}^nC_0)x^2 + ...$

Hence $A_0 = 1$; $A_1 = {}^nC_1$;

$A_2 = {}^nC_2 + 2$ which are in A.P.]

4.[C] Let $z_1 = a + ib \qquad z_2 = c + id$

$Re(z_1 + z_2) = 0 \Rightarrow a + c = 0$ i.e. $c = -a$

$Im(z_1z_2) = 0 \quad \Rightarrow ad + bc = 0$ i.e. $a(d-b) = 0$

$\Rightarrow d = b \quad [\because a = -c \neq 0]$

$z_1 = a + ib$

$= -c + id$

$= -(c - id) \Rightarrow z_1 = -\bar{z}_2$

5.[B] $f(x) = |x|^3$

$$\therefore\ f'(x) = \begin{cases} 3|x|^2 \cdot \dfrac{x}{|x|} & x \neq 0 \\ 0 & x = 0 \end{cases}$$

6.[A]

$$I = \int_{\pi/4}^{\pi/2} \sqrt{2+\sqrt{2+2\cos 4x}}\, dx = \int_{\pi/4}^{\pi/2} \sqrt{2-2\cos 2x}\, dx$$

$$= 2\int_{\pi/4}^{\pi/2} \sin x dx$$

$$= 2\left(-\cos x\right)_{\pi/4}^{\pi/2} = \sqrt{2}$$

7.[C] $1 + x^2 = t^2 \Rightarrow I = \int (t^2 - 1)\, dt = \dfrac{t^3}{3} - t$

$$= \frac{(1+x^2)^{3/2}}{3} - \sqrt{1+x^2}$$

$$= \frac{(1+x^2)\sqrt{1+x^2}}{3} - \sqrt{1+x^2}\,(1+x^2-x^2)$$

$$= \frac{1}{3}x^2\sqrt{1+x^2} - \frac{2}{3}(1+x^2)^{3/2}$$

8.[C] $\because \cot^{-1}(x-1) + \cot^{-1}(6-x) = \cot^{-1}(x-2)$

Take cot of both sides, we get

$$\Rightarrow \left[\frac{(x-1)(6-x)-1}{6-x+x-1}\right] = (x-2)$$

$$\Rightarrow -\frac{x^2+7x-7}{5} = x-2$$

$$\Rightarrow x^2 - 2x - 3 = 0$$

$$\Rightarrow (x-3)(x+1) = 0$$

$$\Rightarrow x = 3\ ;\ x = -1$$

both satisfy the given equation.

9.[C] $\underset{x\to 0}{Lim} \dfrac{\log_e(1+3f(x))}{2f(x)} = \dfrac{3}{2}$

10.[A] A 3×3 matrix is equivalent to I_3 if it is non-singular.

Hence $\begin{vmatrix} 1 & 2a & 2 \\ 0 & -1 & 1 \\ a & 1 & 3 \end{vmatrix} = 0$

$$\Rightarrow -4 + a(2a+2) = 0$$

$$\Rightarrow 2a^2 + 2a - 4 = 0$$

$$\Rightarrow (a+2)(a-1) = 0 \rightarrow a = -2, 1$$

11.[B] $x - y = 2$

$x + y + xy$ is to be minimized.

Putting $y = x - 2$.

we get, $f(x) = 2x - 2 + x(x-2)$

$f'(x) = 2 + 2x - 2 = 0$ at $x = 0$

$f''(x) = 2 \Rightarrow x = 0$ is a point of minima

Thus minimum value is at $x = 0$ & $y = -2$.

12.[A] $\dfrac{f(3)-f(1)}{3-1} = f'(c)$, for some c such that $1 < c < 3$

$$f'(c) = \frac{f(3)-2}{2} < 2$$

$$\therefore f(3) < 6$$

13.[B] Property of parabola : The portion of a tangent to a parabola cut off between the directrix & the curve subtends a right angle at the focus

hence required locus is a point (focus)

14.[C] Consider cases when $z = 0, 1, 2, \ldots, 11$

$$\Rightarrow 34 + 31 + 28 + \ldots\ldots + 1 \text{ (12 times)}$$

$$= \frac{12}{2}(1 + 34) = 210$$

15.[D] A : Target I is hit $= P_1$;

B : Target II is hit $= P_2$;

C : none is hit $1 - (P_1 + P_2)$

$$\Rightarrow P(E) = \frac{P_2}{1-P_1}$$

16.[A] $\dfrac{t_p + t_q}{2} = \dfrac{t_r + t_s}{2}$

$$\Rightarrow a + (p-1)d + a + (q-1)d = a + (r-1)d + a + (s-1)d$$

$$\therefore\ p + q = r + s.$$

17.[C] $\frac{dy}{dx} = \frac{2y+3x}{2x+5y} \Rightarrow \left.\frac{dy}{dx}\right]_{(x_1, y_1)} = 0$

& $\left.\frac{dy}{dx}\right]_{(x_2, y_2)} = \infty$

$\Rightarrow$ tangents are perpendicular

18.[D] The given expression is equal to

$(\sin 47° + \sin 61°) - (\sin 11° + \sin 25°)$

$= 2 \sin 54° \cos 7° - 2 \sin 18° \cos 7°$

$= 2 \cos 7° (\sin 54° - \sin 18°)$

$= 2 \cos 7° \left[\frac{\sqrt{5}+1}{4} - \frac{\sqrt{5}-1}{4}\right] = \cos 7°.$

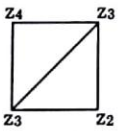
19.[B] $\left|\vec{d}_1\right| = |\vec{p}+\vec{q}|; \left|\vec{d}_2\right| = |\vec{p}-\vec{q}|$

20.[A] $\frac{z_4 - z_1}{z_2 - z_1} = i$ i.e. $z_4 - z_1 = i(z_2 - z_1)$

Also $z_1 + z_3 = z_4 + z_2$

i.e. $z_1 + z_3 = z_1 + i(z_2 - z_1) + z_2$

i.e. $z_3 + iz_1 = (1 + i) z_2$



i.e. $2z_2 = (1 - i) z_3 + (1 - i) i z_1$

$= (1 + i) z_1 + (1 - i) z_3$ ...(i)

$2(z_1 + z_3 - z_4) = (1 + i) z_1 + (1 - i) z_3$

$\therefore \quad 2z_4 = 2z_1 + 2z_3 - (1 + i) z_1 - (1 - i) z_3$

$= (1 - i) z_1 + (1 + i) z_3$ ...(ii)

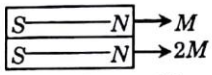
PHYSICS

21.[B] Time period of magnet oscillating in uniform $B = T = 2\pi\sqrt{\frac{I}{MB}}$

M = magnetic moment

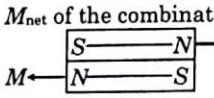
$T \propto \frac{1}{\sqrt{M}}$

M_{net} of the combination = $M + 2M = 3M$



$T_1 \propto \frac{1}{\sqrt{3M}}$

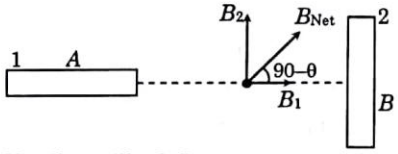
M_{net} of the combination $= 2M - M = M$



$T_2 \propto \frac{1}{\sqrt{M}}$

$\frac{T_1}{T_2} = \sqrt{\frac{M}{3M}} \Rightarrow T_2 = \sqrt{3}\, T_1$

22.[A]



Needle will deflect to magnetic field direction at P

At P, B is produced by magnet A and B

B due to magnet $B = B_1$

B due to magnet $A = B_2$

Formula of B : At axis of magnet $A = \frac{2\mu_0 M}{d^3}$

At equatorial axis of magnet $B = \frac{\mu_0 M}{d^3}$

$\therefore B_2 = \frac{\mu_0 M}{d_2^3}$

$B_1 = \frac{2\mu_0 M}{d_1^3}$

$\tan(90 - \theta) = \frac{B_2}{B_1}$

$\frac{B_2}{B_1} = \cot\theta$

$\frac{1}{2}\left(\frac{d_1}{d_2}\right)^3 = \cot\theta$

$\frac{d}{d_2} = (2 \cot \theta)^{1/3}$

23.[D] For tangent galvanometer

$\frac{\mu NI}{2R} = B_H \tan\theta$

$\therefore \frac{N_1}{N_2} = \frac{\tan\theta_1}{\tan\theta_2} \Rightarrow \frac{N_1}{N_2} = \frac{\tan 60°}{\tan 45°} = \frac{\sqrt{3}}{1}$

24.[D] First e^- come near then goes away. Due to which first magnetic field due to moving electron in loop increase and then decrease.

25.[B] B due to solenoid = $\mu_0 ni$
flux through the coil = $N \times B \times A$
Area of coil where $A = 1.2 \times 10^{-3}$ m²
N = number of turns in coil = 300
flux = $\phi = 300 \times \mu_0 ni \times 1.2 \times 10^{-3}$
Current initial value = 2 Amp
final current = – 2 Amp
$\Delta i = -4$ Amp
$\Delta\phi = 300\ \mu_0 n \times 1.2 \times 10^{-3} \Delta i$
$\Delta t = 0.25$ sec

$$\text{emf} = -\frac{\Delta\phi}{\Delta t} \quad \{\text{Faraday law}\}$$

$$= -300 \times \mu_0 n \times 1.2 \times 10^{-3} \frac{\Delta i}{\Delta t}$$

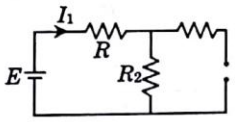
$$\text{emf} = -300 \times 4\pi \times 10^{-7} \times \frac{2000}{0.3} \times 1.2 \times 10^{-3} \frac{(-4)}{0.25}$$

$$= 1000 \times 4\pi \times 10^{-7} \times 2 \times 1.2 \times 4 \times 4$$

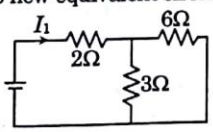
$$= 482 \times 10^{-4} = 48 \text{ mV}$$

26.[B] Just after closing of switch inductor behave as open circuit
equivalent circuit is shown

$$I_1 = \frac{E}{R_1 + R_2} = \frac{10}{2+3} = \frac{10}{5} = 2 \text{ Amp}$$



27.[A] After long time induced emf in L become zero so, L is replaced with simple conducting wire. so new equivalent circuit is shown.

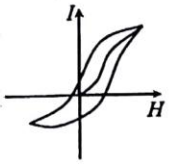


$$I_1 = \frac{E}{R_{eq}}$$

$$R_{eq} = 2 + R_{eq} \text{ of } 6 \& 3\Omega = 2 + \frac{6 \times 3}{6+3} = 2 + 2 = 4$$

$$I_1 = \frac{10}{4} = 2.5 \text{ amp}$$

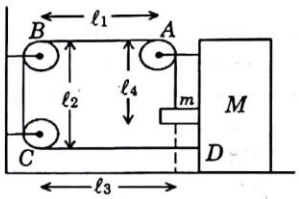
28.[D] Magnetic susceptibility is the slope of I-H curve.



Slope of I–H curve for ferro may be positive, negative and zero so never be constant

29.[C] When contact is broken net emf is $e + E$ i.e. emf get increased. Here e is the induced emf in L due to abrupt charge in current or breaking of contact, as we can see emf is increased so brightness of bulb increases.

30.[D] Let X be the leftward displacement of m and x and y be the leftward and downward displacement of M.
Let $AB = \ell_1$; $BC = \ell_2$: $CD = \ell_3$ and $Am = \ell_4$
When M moves towards left, say by x, then



$AB = (\ell_1 - x)$
$BC = \ell_2$
$CD = \ell_3 - x$
$Am = \ell_4 + y$
total length of string remain constant
$\therefore \ell_1 - x + \ell_2 + \ell_3 - x + \ell_4 + y = \ell_1 + \ell_2 + \ell_3 + \ell_4$
$\therefore$ 2x = y
acceleration of $M = a_M = 2$ m/s²
$a_x = 2$ m/s²
$2x = y$
double differentiating this equation
$2a_x = a_y$
$a_y = 2a_x = 4$ m/s²
a_y is downward acceleration of $m = 4$ m/s²
m is also moving in left direction along with M.
$\therefore$ m has acceleration in horizontal direction also horizontal acceleration of m is same as that of M
i.e. 2 m/s²
$\therefore$ Net acceleration of m = $\sqrt{2^2 + 4^2} = 2\sqrt{5}$

31.[D] P-T graph is a straight line passing through the origin.
Therefore V = constant
$\therefore$ work done on the gas is zero.

Further, density of the gas, $\rho = \frac{m}{V}$

$\therefore \rho \propto \frac{1}{V}$

Since volume of the gas is constant, density of the gas is constant.
$PV = nRT$

$P = \left(\frac{nR}{V}\right) T$

i.e., slope of P-T line is proportional to n.

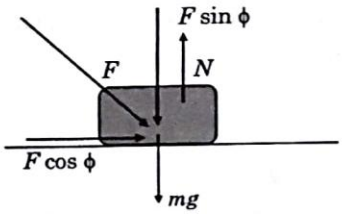
32.[B] The moment of inertia for the system can be calculated by adding the two individual moments of inertia as following :
$I_{total} = I_0 + I_{clay}$
$I_{clay} = MR^2$

$R = \sqrt{2}\frac{L}{2}$

$I_{clay} = M\left(\sqrt{2}\frac{L}{2}\right)^2 = \frac{ML^2}{2}$

$I_{total} = I_0 + \frac{ML^2}{2}$

33.[B] The key to finding the coefficient of friction μ is in calculating the correct normal force acting on the block
$\sum F_y = ma_y$
Free body diagram

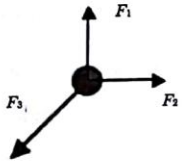


block does not move in y direction
$\therefore \quad a_y = 0$
$\therefore \quad N = F \sin\phi + mg$

$\mu = \frac{F_{friction}}{N} = \frac{f}{F \sin\phi + mg}$

34.[C] The diagram suggests that the box is currently moving to the right, and in the process of slowing down due to a force of friction that is causing it to accelerate in the opposite direction (slowing down the box).

35.[A] By definition, the object is in equilibrium, either static (unmoving) or dynamic (moving with a constant velocity). If the object has acceleration a = 0, the net force acting on the mass must be 0 as well :



$F_{net} = ma$
$F_{net} = m(0) = 0$
with forces F_1 and F_2 in the x-y plane, the force that will counteract them must lie in the x-y plane as well, as shown. The magnitude of that force F_3 is equal to the vector sum of F_1 and F_2 and can be calculated as follows :

$\sum F_x = 0 = \bar{F}_2 - \bar{F}_{3-x}$

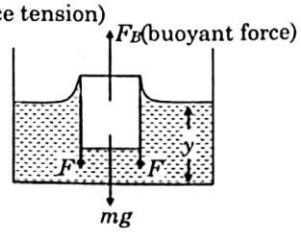
$\sum F_y = 0 = \bar{F}_1 - \bar{F}_{3-y}$

$|F_3| = \sqrt{F_{3-x}^2 + F_{3-y}^2}$

$= \sqrt{F_1^2 + F_2^2} = F_1\sqrt{2}$

both graphically and analytically, we can see that the magnitude of F_3 is not the same as that of F_1.

36.[C] Mass of the cube = 30 g, density of water = ρ = 1 gm/cm^3, surface tension of water = σ = 70 dyne/cm
a =length of each face of the cube = 4 cm, let y be the distance of the lower face of the cube from the surface of water.
When the cube floats freely in water
F(Force due to surface tension)



upward forces = downward force

$F_B = a^2y\rho g$

$F = 4a\sigma$

$F_B = F + mg$

$a^2y\rho g = 4a\sigma + mg$

$a^2y\ \rho\ g = mg + 4a\ \sigma$

$$\therefore y = \frac{mg + 4a\sigma}{a^2\rho g} = \frac{30\times 980 + 4\times 4\times 70}{4\times 4\times 1\times 980}$$

$$= \frac{29400 + 1120}{15680} = \frac{30520}{15680} = 1.95 \text{ cm}$$

37.[D] $u = 21$ cm ; $f = \frac{R}{2} = \frac{10}{2} = 5$ cm

on introducing the glass slab, the object as well as the image will be shifted from the mirror through a distance

$d = t\left(1 - \frac{1}{\mu}\right) = 3\left(1 - \frac{1}{1.5}\right) = 1$ cm, so that apparent distance of the object = 20 cm (i.e.) $u = 20$ cm

By the mirror formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$v = \frac{20}{3}$ cm = 6.67 cm

$\therefore$ distance of the final image from the mirror = 6.67 + 1 = 7.67 cm.

38.[C] The length of the pendulum hasn't changed and the only other factor that determines the period of a pendulum is the acceleration due to gravity

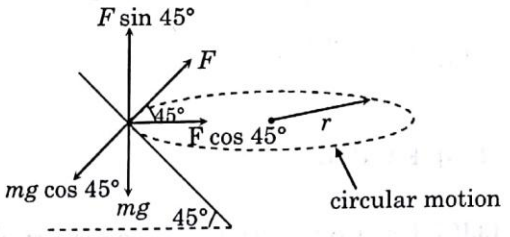
$$T' = 2\pi\sqrt{\frac{\ell}{g}}$$

$$T' = 2\pi\sqrt{\frac{\ell}{\frac{1}{6}g}}$$

$$T' = \sqrt{6}\left(2\pi\sqrt{\frac{\ell}{g}}\right)$$

$$T' = \sqrt{6}\,T$$

39.[B] In vertical direction aeroplane is in equilibrium



$\therefore F\sin 45° = mg$

$$F = \frac{mg}{\sin 45°}$$

Lift force $F = \frac{mg}{\sin 45°}$

The centripetal force is provided by the component of lift force

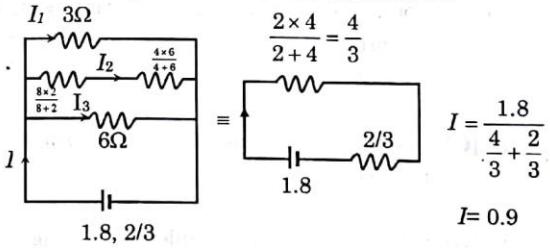
$$\Rightarrow F\cos 45° = \frac{mv^2}{r}$$

$$\Rightarrow \frac{mg}{\sin 45°}\cos 45° = \frac{mv^2}{r}$$

$$r = \frac{mv^2}{mg} = \frac{v^2}{g} = \frac{\left(540\times\frac{5}{18}\right)^2}{10} = 2250 \text{ m}$$

40.[A] 8 Ω and 2 Ω are in parallel and similarly 6 Ω and 4 Ω are also in parallel combination

$\therefore$ equivalent circuit is shown below



0.9 is divided in ratio $\frac{1}{3}:\frac{1}{4}:\frac{1}{6}$

$I_1 : I_2 : I_3 = \frac{1}{3}:\frac{1}{4}:\frac{1}{6}$

$$I_1 = \frac{\frac{1}{3}}{\frac{1}{3}+\frac{1}{4}+\frac{1}{6}}\times I = 0.9\times\frac{1}{3\times\frac{4+3+2}{12}}$$

$$= \frac{0.9}{3}\times\frac{12}{9} = 0.4\ A$$

CHEMISTRY

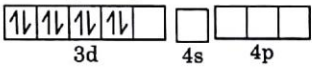
41.[A] $\frac{256}{2^6} = \frac{256}{64} = 4.$

42.[A] $FeO.Cr_2O_3 \longrightarrow +2, +3.$

43.[C] Lower S.R.P. containing ion can displace higher S.R.P. containing ion.

44.[C] $Ni(CN)_4$ Ni : [Ar] $3d^8\ 4s^2 = t_{2g}^{2,2,2}\ e_g^{2,2}$

CN^- is a strong filed ligand, hence it will cause pairing of electrons. Hence, dsp^2



Cr $(H_2O)_6^{+2}$ Cr^2 : [Ar] $3d^4 4s^o$

octahedral complex : d^2sp^3

45.[B] $4r = a\sqrt{2}$

$a = \frac{4r}{\sqrt{2}} = \frac{4 \times 1.28}{\sqrt{2}}$ Å $= 3.62$ Å

46.[A] For a non-ideal solution showing postitive deviation from Raoult's Law: $\Delta H > 0$ and $\Delta V > 0$

47.[C] Anode mud contains Ag, Au as impurities.

48.[D] (A) AgCl dissolves completely forming $[Ag(NH_3)_2]Cl$;

$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$

(B) AgBr dissolves completely forming $[Ag(NH_3)_2]$ Br soluble complex.

$AgBr + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Br + 2H_2O.$

(C)

$Ag_2CrO_4 + 4NH_3 \longrightarrow 2[Ag(NH_3)_2]^+ + CrO_4^{2-}$

(D) AgI is insoluble in concentrated aqueous NH_3.

49.[C] $Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$

$CuO + B_2O_3 \xrightarrow{\Delta} Cu(BO_2)_2$

$2Cu(BO_2)_2 + 4NaBO_2 + 2C \xrightarrow{\Delta} 2Cu$ (red and opaque) (लाल तथा अपारद र्शी) $+ 2Na_2B_4O_7 + 2CO\uparrow$

50.[D] (A) $KMnO_4 + Cu_2O + KOH \longrightarrow 2Cu(OH)_2 + K_2MnO_4.$

(B) $2KMnO_4 + 2K_2CO_3 + O_2$ (from KNO_3) $\longrightarrow 2K_2MnO_2 + 2CO_2.$

(C) $HCHO + 2KMnO_4 + 2KOH \longrightarrow 2K_2MnO_4 + H_2O + HCOOH$

(D) In all of the above

51.[D] As it becomes passive by the action of conc. HNO_3forming a protective oxide layer on the surface.

52.[B] $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2 + 4H_2O$

53.[A] Gold sol and $Fe(OH)_3$ sol are hydrophobic.

54.[B] Ph-X + 2Na $\xrightarrow{ether}$ Ph-Ph

(it is the Fittig reaction)

55.[B] o-nitrophenol is more acidic than phenol because –I, –m groups (NO_2) increases acidic character and +I, +m groups (CH_3, OCH_3) decreases acidic character.

56.[C] Increasing order of reactivity of alcohol with HBr $\propto$ stability of carbocation intermediate.

57.[D] Aniline is ortho-para directing so meta isomer is not possible.

58.[A]

59.[A] $CH_3–\underset{\displaystyle Br}{\underset{|}{CH}}–CH_2–CH_3$ 2nd Carbon of 2-Bromobutane is chiral so molecule is optically active.

60.[B] Factual

BIOLOGY

61.[A] A = primary follicle, B = maturing follicle, C = corpus luteum, D = graafian follicle, E = medulla, F = germinal epithelium

62.[D] All

63.[B] Is formed from the remnants of graafian follicles after ovulation

64.[A] a-iii, b-ii, c-i, d-iv

65.[A] I & II true, III false

66.[C] Outer wall of Bowman's capsule is made up of stratified epithelial cells

67.[C] Blood minus, blood corpuscles & plasma proteins

68.[B] Chloride shift

69.[A] Formation of fertilization membrane

70.[A] Infections that in other people are minor

71.[B] Spermatocytes, Spermatids, Spermatogonia, Spermatozoa

72.[A] Temperature will decrease

73.[B] Plestocene

74.[B] Catla catla

75.[D] Condom

76.[D] Protonema

77.[B] Naked seeds

78.[A] Cell wall is present

79.[B] Telophase

80.[A] Chlorophyll-a has methyl group and chlorophyll-b has aldehyde group in position X

PART-II [Two Marks Questions]

MATHEMATICS

81.[A] Let $\lambda = \tan\theta$

$\therefore x = 2\sin 2\theta$

$y = 2\cos 2\theta$

$\therefore x^2 + y^2 - xy = 4 - 2\sin 4\theta$

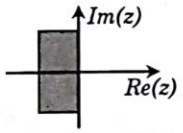
$x^2 + y^2 - xy \in [2, 6]$

$\therefore a + b = 8$

82.[B] $\log_3|2z-1| > \log_3|2z+1|$

$\Rightarrow (2z-1)(2\bar{z}-1) > (2z+1)(2\bar{z}+1)$

$\Rightarrow 4|z|^2 - 2(z+\bar{z}) + 1 > 4|z|^2 + 2(z+\bar{z}) + 1$

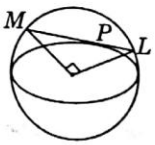


$\Rightarrow 4.2\, Re(z) < 0 \quad \Rightarrow Re(z) < 0$

83.[B] Point P will be $(a\cos 60°, b\sin 60°)$

Tangent will be $\frac{x\cos 60°}{a} + \frac{y\sin 60°}{b} = 1$

$\frac{x}{2a} + \frac{y\sqrt{3}}{2b} = 1 \quad \ldots (1)$



Homogenise $x^2 + y^2 = a^2$ with the help of eqn. (1)

We get $x^2 + y^2 = a^2\left[\frac{x}{2a} + \frac{y\sqrt{3}}{2b}\right]^2$

$$x^2 + y^2 = a^2\left[\frac{x^2}{4a^2} + \frac{3y^2}{4b^2} + \frac{xy\sqrt{3}}{2ab}\right]$$

$$\frac{3x^2}{4} + y^2\left(1 - \frac{3a^2}{4b^2}\right) - \frac{a\sqrt{3}xy}{2b} = 0$$

For 90° at centre

$$\frac{3}{4} + 1 - \frac{3a^2}{4b^2} = 0$$

$$\frac{3}{4}\frac{a^2}{a^2(1-e^2)} = \frac{7}{4}$$

$$1 - e^2 = \frac{3}{7} \Rightarrow e^2 = \frac{4}{7} \Rightarrow e = \frac{2}{\sqrt{7}}$$

84.[D] $f(x)=\lim_{n\to\infty}\dfrac{x^{1/n}-x^{1/(n+1)}}{\frac{1}{n^2}}$

$=\lim_{n\to\infty}\dfrac{x^{1/n}\left(1-x^{-1/n(n+1)}\right]}{\left[-\frac{1}{n(n+1)}\right]}\cdot\left[-\dfrac{n^2}{n(n+1)}\right]$

using L – H rule

$=(-\log_e(x))(-1)=+\log_e x$

$\int x.f(x)\,dx=\int x.(\log_e x)\,dx$

$=\log_e x.\dfrac{x^2}{2}-\int\dfrac{1}{x}.\dfrac{x^2}{2}dx=\log_e x.\dfrac{x^2}{2}-\dfrac{x^2}{4}+C$

85.[C] $5(\log_y x+\log_x y)=26,\ xy=64$

$\Rightarrow 5\left(\log_y x+\dfrac{1}{\log_y x}\right)=26$

Put $\log_y x=t$

$\therefore\ 5(t^2+1)=26t\Rightarrow 5t^2-26t+5=0$

$\Rightarrow\ t=5,\ \dfrac{1}{5}$

$\therefore\ \log_y x=5,\ \dfrac{1}{5}$

So $x=y^5,\ y^{1/5}$

But $xy=64\Rightarrow y^5.y=64$ or $y^{1/5}.y=64$

$\therefore\ y=2$ or 32

$\therefore$ Solution set will be (32, 2) & (2, 32)

$\therefore\ a+b+c+d=32+2+2+32=68$

86.[C] Limit $=e^{\lim_{n\to\infty}n\left(\left(\frac{n}{n+1}\right)^{\alpha}+\sin\frac{1}{n}-1\right)}$

$=e^{\lim_{n\to\infty}\left(\frac{\sin(1/n)}{1/n}\cdot\frac{(1+(1/n))^{\alpha}-1}{1/n}\cdot\frac{1}{(1+(1/n))^{\alpha}}\right)}$

$=e^{1-\alpha}$

87.[A] $\alpha=\lim_{n\to\infty}\dfrac{1+4+9+\ldots+n^2}{n^3+1}$

$=\lim_{n\to\infty}\dfrac{n(n+1)(2n+1)}{6(n^3+1)}$

$\beta=\lim_{n\to\infty}\left(\dfrac{\sin 2x}{2x}\right)\left(\dfrac{8x}{\sin 8x}\right)\times\left[\dfrac{2x}{8x}\right]$

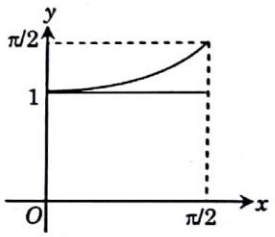
$\beta=\dfrac{1}{4}$

$\alpha\beta=\dfrac{1}{12}$

$\alpha+\beta=\dfrac{7}{12}$

$12x^2-7x+1=0$

88.[A]



Since, $\sin x\dfrac{dy}{dx}+y\cos x=1$

$\dfrac{dy}{dx}+y\cot x=\operatorname{cosec} x$

$\text{IF}=e^{\int\cot x\,dx}=e^{\ell n(\sin x)}=\sin x$

$y\sin x=\int\operatorname{cosec} x.\ \sin x\,dx$

$y\sin x=x+C$

If $x\to 0$, y is finite

$\therefore\ C=0$

$\therefore\ y=\dfrac{x}{\sin x}$

Now, $I<\dfrac{\pi^2}{4}$ and $I>\dfrac{\pi}{2}$

Hence, $\dfrac{\pi}{2}<I<\dfrac{\pi^2}{4}$

89.[B] Apply

$-\dfrac{(a-b)^2-4(1-a-b)}{4}>\dfrac{(a+b)^2-4(1+a+b)}{4}$

$a^2+b^2<4$

90.[D] Let $T_k=\dfrac{(k+2)\sqrt{k}-k\sqrt{k+2}}{k(k+2)^2-k^2(k+2)}$

$=\dfrac{(k+2)\sqrt{k}-k\sqrt{k+2}}{2k(k+2)}=\dfrac{1}{2}\left[\dfrac{1}{\sqrt{k}}-\dfrac{1}{\sqrt{k+2}}\right]$

$\therefore\ T_1=\dfrac{1}{2}\left[\dfrac{1}{\sqrt{1}}-\dfrac{1}{\sqrt{3}}\right]$

$$T_2 = \frac{1}{2}\left[\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{4}}\right]$$

$$T_3 = \frac{1}{2}\left[\frac{1}{\sqrt{3}} - \frac{1}{\sqrt{5}}\right] \text{ and so on}$$

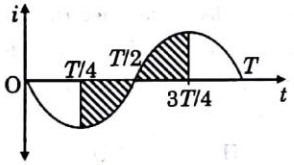
$\therefore$ As $k \to \infty$, sum $= \frac{1}{2}\left[1 + \frac{1}{\sqrt{2}}\right]$

$$= \frac{1+\sqrt{2}}{2\sqrt{2}} = \frac{\sqrt{1}+\sqrt{2}}{\sqrt{8}}$$

$\Rightarrow a + b + c = 11$

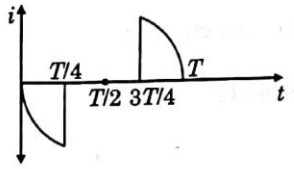
PHYSICS

91.[D] Emf induced when a loop rotates in a magnetic field is ($e = Ns\ B\ \omega \sin \omega t$), which is a sinusoidal function. Therefore, induced current will also be sinusoidal as shown :



The curve will be negative, because initially the flux decreases from $t = 0$ to $T/4$ and then increases from $t = \frac{3T}{4}$ to $\frac{T}{4}$.

But from $t = \frac{T}{4}$ to $\frac{3T}{4}$, there will be no induced current as there is no field on the right side. Hence, the current produced will be as shown :



Hence (D).

92.[D] In steady state current from battery $= \frac{10}{2} = 5\text{A}$

In parallel inductors $L_1I_1 = L_2I_2$ all the time

$$\Rightarrow i_1 = \frac{L_2}{L_1 + L_2} i = \frac{3}{3+2} \times 5 = 3\text{A}$$

93.[B] Snell's law $= \mu_0 \sin(90^\circ - \theta)$

$$= \mu_0\left(1 - \frac{x}{d}\right) \sin 90^\circ$$

$$\Rightarrow \left(1 - \frac{x}{d}\right) = \cos\theta \quad \Rightarrow x = d(1 - \cos\theta)$$

94.[B] Using Mosely's law for both cobalt and impurity

$$\sqrt{f} = K(Z-1) \Rightarrow \sqrt{\frac{c}{\lambda}} = K(Z-1)$$

$$\Rightarrow \sqrt{\frac{c}{\lambda_{co}}} = K(Z_{co} - 1) \text{ and } \sqrt{\frac{c}{\lambda_x}} = K(Z_x - 1)$$

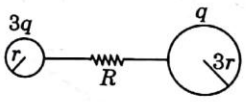
$$\Rightarrow \sqrt{\frac{\lambda_{co}}{c}} = \frac{Z_x - 1}{Z_{co} - 1} = Z_x = 40$$

95.[C] Let charge on smaller sphere be x and on larger sphere be $4q - x$

Force between them is given by

$$F = \frac{kx(4q - x)}{d^2}$$

$$\frac{dF}{dx} = 0 \quad \Rightarrow 4q - 2x = 0 \Rightarrow x = 2q$$



$$\frac{d^2F}{dx^2} = \frac{K}{d^2}(-2) < 0$$

$\therefore$ it represents a maximum.

Final charges on the smaller sphere and the larger sphere are q & $3q$ respectively as required by the equality of potentials

$\therefore$force will increase until the charges become equal and after that force will decrease.

96.[A] Initially at resonance : $X_L = X_E \Rightarrow Z = R$.

$$\therefore \quad i_0 = \frac{\varepsilon_0}{R} = 10\sqrt{2}\ A$$

After increasing frequency : $X_L > X_c$

$\omega L > 1/\omega C$

$\omega > \frac{1}{\sqrt{LC}} \Rightarrow \omega > \omega_0$ (i.e frequency increases)

and $i = \frac{\varepsilon_0}{\sqrt{R^2 + X^2}} = \frac{\varepsilon_0}{\sqrt{2R}} = i_0/\sqrt{2}$

$= 10$ amp.

97.[A] Oscillations represented by curve 2 lags in phase by $\pi/2$ and the periods are same. Amplitude of curve 2 is double that of 1.

98.[A] Stages 1 and 2 are at same temperature also stages 4 and 5 are at same temperature. As, V_P is more at higher temperature and same at all stages at equal temperature.

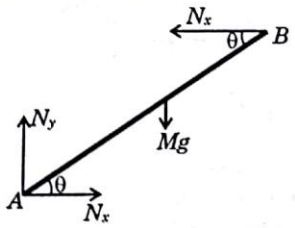
$\therefore V_{P3} > V_{P1} = V_{P2} > V_{P4} = V_{P5}$

Hence (A).

99.[D] In the process of collision, the electron (because of very low mass in comparison to hydrogen atom) can loose upto 10 eV. 10 eV is sufficient to ionize the hydrogen atom or excite to higher excited state from first excited state.

Hence, the collision can be elastic, inelastic or perfectly inelastic.

100.[B] The free body diagram of rod is



Where N_x and N_y are horizontal and vertical components of reaction exerted by wall on rod. Net torque on rod about left end A is zero

$$\therefore Mg\frac{\ell}{2}\cos\theta = N_x\,\ell\,\sin\theta \Rightarrow N_x = \frac{Mg}{2\tan\theta}.$$

CHEMISTRY

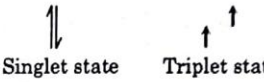
101.[D] (I) 2 pentanol & 3-Pentanol P.I.

(II) 2^{Ω} amine and 3^{Ω} amine functional group isomer

(III) Not isomer (not equal M.P.)

102.[C] I & II do not show G.I. because in cycloalkene G.I. is only possible after 8 mem. ring-

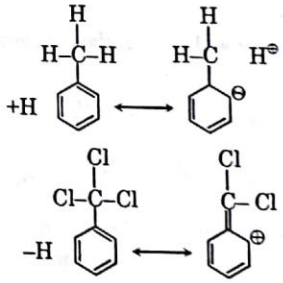
103.[D]



Singlet state Triplet state

In triplet state electron exist in different orbital so $e - e^-$ repulsion is less in triplet carbene or nitrene that is why triplet is more stable than singlet

104.[C] Hyper conjugation is a electron donating effect increases electron density on ortho & pera position where as revers hyperconjugation is a electron with drawing, decrease electron density at ortho & para position & oriented the coming electrophile to attack on meta position

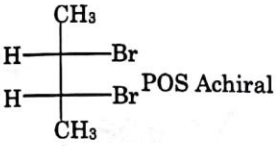


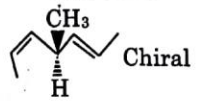
105.[D] Acidic strength order

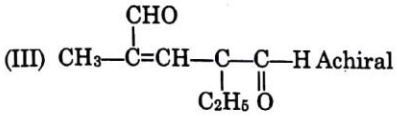
$RSO_3H > RCOOH > H_2CO_3 >$  $> H_2O > R\text{–}OH > R\text{–}H$

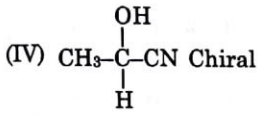
 $< NH_3$ Basic strength

Acid Base reaction occur more stronger acid & more stronger base side to less stronger acid & less stronger base

106.[B] (I) 
POS Achiral

(II) 
Chiral

(III) 
Achiral

(IV) 
Chiral

107.[B] Rate of attack of HX on alkane $\propto$ stability of carbocation $\propto$ EDGA at DB

108.[D] Three unpaired electron is present in $(CrBr_6)^{3-}$ & $(Ni(H_2O)_6)^{2+}$

Magnetic moment

$= \sqrt{n(n+2)} = \sqrt{3(3+2)} = 3.87$

109.[D] $Fe(CN)_6^{-3} = 35$

$[V(CO)_5]$ V = 35

$[Ti(\sigma - C_5H_5)_2\ (\pi - C_5H_5)_2]^0 = 34$

$[Fe(CO)_2(NO)_2]^0 = 36$

110.[C] $2A \xrightarrow{K} B + 3C$

$t = 0$	380	0	0
$t = t$	$3p_0 - 2x$	x	$3x$

given, $4x = P_0$

$$x = \frac{P_0}{4}$$

$$\therefore\ K_{eff} = 2K = \frac{1}{t}\ell n\ \frac{6}{5}$$

$$Kt = \frac{1}{2}\ell n\ (1.2)$$

BIOLOGY

111.[A] 5 : 3

112.[D] Normal father and haemophiliac mother

113.[C] 5'TATAAT3'

114.[B] 7

115.[A] AIDS virus infection

116.[A] Polypeptide of 24 amino acid

117.[C] 30 map unit

118.[B] Type-II

119.[A]

A	B	C
Oestrogen	Islet of langerhance α-cells	Anterior lobe of pituitary

120.[C]

CROSS	PHENOTYPIC RATIO
tt × Tt	2 : 1

KVPY

Kishore Vaigyanik Protsahan Yojana

Practic
Set-5

Stream – SX

Hints & Solutions

Answer key

1.(D)	2.(D)	3.(B)	4.(D)	5.(C)	6.(C)	7.(B)	8.(B)	9.(A)	10.(D)	11.(B)	12.(B)	13.(B)	14.(D)
15.(A)	16.(B)	17.(B)	18.(A)	19.(D)	20.(B)	21.(C)	22.(C)	23.(C)	24.(D)	25.(B)	26.(D)	27.(A)	28.(C)
29.(C)	30.(B)	31.(D)	32.(C)	33.(A)	34.(C)	35.(B)	36.(A)	37.(B)	38.(A)	39.(A)	40.(A)	41.(B)	42.(C)
43.(B)	44.(D)	45.(C)	46.(B)	47.(C)	48.(C)	49.(C)	50.(C)	51.(A)	52.(D)	53.(B)	54.(A)	55.(A)	56.(D)
57.(B)	58.(B)	59.(D)	60.(A)	61.(A)	62.(B)	63.(B)	64.(D)	65.(B)	66.(C)	67.(D)	68.(B)	69.(D)	70.(C)
71.(A)	72.(A)	73.(C)	74.(B)	75.(C)	76.(B)	77.(C)	78.(C)	79.(D)	80.(D)	81.(D)	82.(D)	83.(A)	84.(C)
85.(A)	86.(C)	87.(A)	88.(B)	89.(B)	90.(A)	91.(A)	92.(A)	93.(B)	94.(B)	95.(A)	96.(B)	97.(B)	98.(C)
99.(A)	100.(D)	101.(D)	102.(A)	103.(C)	104.(C)	105.(A)	106.(A)	107.(B)	108.(B)	109.(C)	110.(D)	111.(D)	112.(D)
113.(A)	114.(C)	115.(B)	116.(C)	117.(A)	118.(C)	119.(B)	120.(B)						

PART-I [One Marks Questions]

MATHEMATICS

1.[D] $3x - 6y + 2z + 5 = 0$ ...(i)

$-4x + 12y - 3z + 3 = 0$ ...(ii)

$a_1a_2 + b_1b_2 + c_1c_2 = -12 - 72 - 6 < 0$

hence '+' sign bisector is origin containing and is also acute angle bisector

$$\therefore \frac{3x-6y+2z+5}{7} = \frac{+(-4x+12y-3z+3)}{13}$$

$$67x - 162y + 47z + 44 = 0$$

2.[D] If $5x \geq 15$ i.e. $x \geq 3$, then

$x^2 - 6x - 5x + 15 - 5 = 0$ i.e. $x^2 - 11x + 10 = 0$

i.e. $x = 1, 10$

$\therefore$ $x = 10$ is a solution

if $5x < 15$ i.e. $x < 3$,

then $x^2 - 6x + 5x - 15 - 5 = 0$

i.e. $x^2 - x - 20 = 0$ i.e. $x = 5, -4$

$\therefore x = -4$ is a solution

Thus $\ell = 1$, $m = 1$

3.[B] $r = 3$ or 5; $r = 0$ is not possible

4.[D] Note that $m = \omega$ (cube root of unity)

$(1-\omega)^2 (\omega - \omega^2)^2 (1-\omega^2)^2$

$= (1 + \omega^2 - 2\omega)(\omega^2 + \omega^4 - 2)(1 + \omega^4 - 2\omega^2)$

$= (-3\omega)(-3)(-3\omega^2) = -27$

5.[C] $a = -1$, $b = 1$

6.[C]

$$\lim_{n\to\infty} \frac{1}{n}\left[1 + \sqrt{\frac{n}{n+1}} + \sqrt{\frac{n}{n+2}} + \sqrt{\frac{n}{n+3}} + \ldots + \sqrt{\frac{n}{4n}}\right]$$

$$= \lim_{n\to\infty} \frac{1}{n}\left(\sum_{r=0}^{3n} \frac{1}{\sqrt{1+r/n}}\right) = \int_0^3 \frac{1}{\sqrt{1+x}}\,dx = 2.$$

7.[B] $$B = 2.2\begin{vmatrix} f & d & e \\ n & \ell & m \\ c & a & b \end{vmatrix}$$

[Taking 2 common from R_2 and C_2]

$$= 2\begin{vmatrix} 2f & d & e \\ 2n & \ell & m \\ 2c & a & b \end{vmatrix} = 2\begin{vmatrix} 2c & a & b \\ 2f & d & e \\ 2n & \ell & m \end{vmatrix}$$

[$R_3 \leftrightarrow R_2$, then $R_2 \leftrightarrow R_1$]

$$= 2\begin{vmatrix} a & b & 2c \\ d & e & 2f \\ \ell & m & 2n \end{vmatrix} = 2A$$

$[C_1 \leftrightarrow C_2$ and then $C_2 \leftrightarrow C_3]$

8.[B] $x\frac{dy}{dx} + \frac{3}{\frac{dy}{dx}} = x^2$

$\Leftrightarrow x\left(\frac{dy}{dx}\right)^2 - x^2\frac{dy}{dx} + 3 = 0$

it is of order = 1, degree = 2

9.[A] $f(x) = [x]^2 + [x+1] - 3 = \{[x] + 2\}\{[x] - 1\}$

So, $x = 1, 1.1, 1.2, \ldots$

$\Rightarrow f(x) = 0$ $\quad\therefore f(x)$ is many one

only integral values will be attained

$\therefore f(x)$ is into

10.[D] $\frac{x^2}{16} - \frac{y^2}{9} = 1$ (4 sec θ, 3 tan θ)

$$\frac{3}{2} = \frac{PS_1}{PS_2} = \left|\frac{\frac{4e\sec\theta + 4}{e}}{\frac{4e\sec\theta - 4}{e}}\right| = \left|\frac{e\sec\theta + 1}{e\sec\theta - 1}\right|$$

$\Rightarrow \sec\theta = 4$

and $\tan\theta = \sqrt{16-1} = \sqrt{15}$

11.[B] $\lim_{x\to\infty} \frac{x^n}{e^x} = 0$

is not an indeterminate form for $n \le 0$

$\Rightarrow$ limit is equal to zero

for $n > 0$

$$\lim_{x\to\infty} \frac{x^n}{e^x} = \lim_{x\to\infty} \frac{n(n-1)(n-2)\ldots 1}{e^x} = 0$$

12.[B] $-2\tan\left[\frac{3x+4}{5x+6}\right]^2 \cdot \frac{1}{(5x+6)^2}$

13.[B] $f'(x) = a(e^{ax} - e^{-ax}) < 0$

$\Rightarrow e^{ax} > e^{-ax}$ $\quad(\because a < 0)$

$\Rightarrow x < 0$

14.[D] The point with slope 2 and 3 are normal at (4, –4); (9, –6) where there is no curve, point of normal (am^2, –2 am)

15.[A] $\frac{2}{3} = \frac{\pi a^2 - \pi ab}{\pi a^2} = 1 - \frac{b}{a} = 1 - \sqrt{1-e^2}$

$\Rightarrow e^2 = \frac{8}{9} \Rightarrow e = \frac{2\sqrt{2}}{3}$

16.[B] $x = \frac{p}{p-15}$

$x = 1 + \frac{15}{p-15}$ $\quad\ldots(1)$

Roots are positive $\Rightarrow \frac{15}{p-15} > 0$

i.e. $p \in (-\infty, 0) \cup (15, \infty)$ But $p \in N$

$\therefore p \in (15, \infty)$

From (1), For x to be integer $\frac{15}{p-15}$

should be integer, it is possible

When $0 < p - 15 \le 15$ or $0 < p \le 30$

But $p > 15$

$\therefore p \in (15, 30]$

So, $p = 16, 18, 20, 30$

$\therefore$ No. of positive integral roots are 4.

17.[B] $\frac{1}{2y} - \frac{1}{x+y} = \frac{1}{y+z} - \frac{1}{2y}$

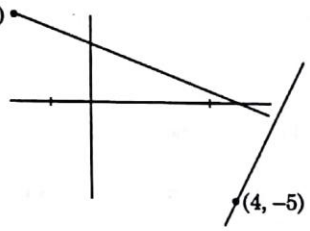
$\Rightarrow \frac{(x+y)-2y}{(x+y)} = \frac{2y-(y+z)}{y+z}$

$\frac{x-y}{x+y} = \frac{y-z}{y+z}$

$\Rightarrow xy + xz - y^2 - yz = xy + y^2 - xz - yz$

$\Rightarrow y^2 = xz$

18.[A]



Distance between the two points (4, –5) and (–2, 3) is 10 which is less than 12. Hence no such line can be drawn.

19.[D] $|\cos x| = \cos x - 2\sin x$

case I when $\cos x \geq 0$

then $\cos x = \cos x - 2\sin x$

$\Rightarrow \sin x = 0$

$\Rightarrow x = n\pi$

But $\cos x > 0$

$\Rightarrow \cos x = 1, x = 2m\pi$

case II when $\cos x < 0$

then $-\cos x = \cos x - 2\sin x$

$\cos x = \sin x$

$\Rightarrow \tan x = 1$

$\Rightarrow \tan x = 1, \cos x < 0$

$\Rightarrow x = (2n+1)\pi + \frac{\pi}{4}, n \in I$

20.[B] $\vec{a} \times \vec{b} = \vec{a} \times (\vec{a} \times \vec{c})$

$= (\vec{a} \cdot \vec{c})\vec{a} - (\vec{a} \cdot \vec{a})\vec{c} = 2\vec{a} - 3\vec{c}$

But $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 1 \\ 1 & -2 & 1 \end{vmatrix} = 3\hat{i} - 3\hat{k}$

Hence $3\vec{c} = 2\vec{a} - (3\hat{i} - 3\hat{k})$

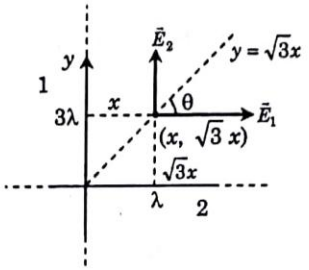
$= (2\hat{i} + 2\hat{j} + 2\hat{k}) - (3\hat{i} - 3\hat{k})$

$= -\hat{i} + 2\hat{j} + 5\hat{k}$

$\Rightarrow \vec{c} = \frac{1}{3}(-\hat{i} + +2\hat{j} + 5\hat{k})$

PHYSICS

21.[C]



Electric field due to long wire is $\frac{\lambda}{2\pi \epsilon_0 r}$, there are two wire one along x and one along y axis

So net $E = \vec{E}_1 + \vec{E}_2$ where E_1 and E_2 is electric field due to each wire

where $\vec{E}_2 = \frac{\lambda}{2\pi \epsilon_0 \sqrt{3}x}\hat{j}$, $\vec{E}_1 = \frac{3\lambda}{2\pi \epsilon_0 x}\hat{i}$

$\vec{E} = \frac{3\lambda}{2\pi \epsilon_0 x}\hat{i} + \frac{\lambda}{2\pi \epsilon_0 x\sqrt{3}}\hat{j}$

θ is the angle that E_{net} made by positive x-axis

$\tan\theta = \frac{E_y}{E_x} = \frac{1}{\sqrt{3}} \div 3 = \frac{1}{3\sqrt{3}}$

22.[C] Applying Kirchoff voltage law $E = L\frac{di}{dt}$

where $E = 2V$ and $L = 4H$

$di = \frac{E}{L}dt$

$\int_0^i di = \int_0^t \frac{E}{L}dt$

$i = \frac{E}{L}t$

$i = \frac{2}{4}t = 0.5\,t$

$i = 0.5t$

Fuse will blow when i become $5A$

So $5 = 0.5\,t$

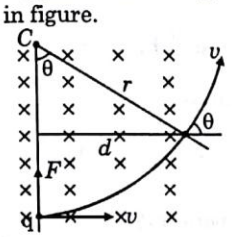
$t = 10$ sec

After 10 sec F will blow

23.[C] q move on circular path in B.

Whose radius $= \frac{mv}{qB} = r$

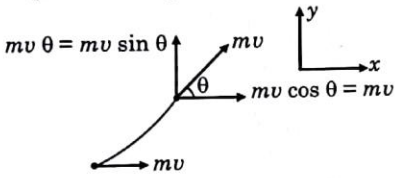
In question width of magnetic field region is very small than r. so charge q will exit from B on opposite side of region path of q is shown in figure.



As $d <<< \frac{mv}{qB}$

using $\sin\theta = \frac{d}{r}$

Impulse is change in momentum



where $r = \frac{mv}{qB}$

$\therefore$ d <<< r $\quad \therefore \sin\theta = \theta$

$\theta = \frac{d}{r}$

Change in momentum

$\Delta P = P_f - P_i$

where $P_f = mv\hat{i} + mv\theta\hat{j}$

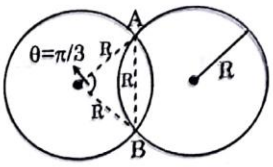
$P_i = mv\hat{i}$

$\Delta P = mv\theta\hat{j}$

$= mv \times \frac{d}{r} = \frac{mv \times d \times qB}{mv}$

Impulse $= qBd$

24.[D] Flux will be maximum when maximum length of ring is inside the sphere. This will occur when the chord AB is maximum Now maximum length of chord AB = diameter of sphere. In this case one arc of ring inside the sphere subtends an angle of $\pi/3$ at the centre of ring.

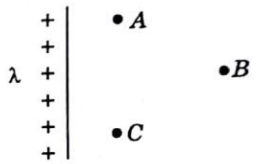


$\therefore$charge on this arc $= \lambda \times$ length of arc

$\therefore$ charge on this arc $= \frac{R\pi}{3}\lambda$

$\therefore \phi = \frac{\frac{R\pi\lambda}{3}}{\epsilon_0} = \frac{R\pi\lambda}{3\epsilon_0}$

25.[B]



Work done to move charge q from A to B

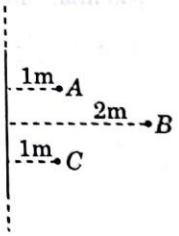
$= W_{AB} = q(V_B - V_A)$

$W_{AB} = q(V_B - V_A)$

Work done to move charge q from B to C

$= W_{BC} = q(V_C - V_B)$

$W_{BC} = q(V_C - V_B)$



$V_B - V_A = \frac{-\lambda}{2\pi\epsilon_0}\ln 2$, $V_C - V_B = \frac{\lambda}{2\pi\epsilon_0}\ln 2$

as $V_B - V_A = -(V_C - V_B)$

$\therefore$as $W_{AB} = -W_{BC}$

26.[D] *K.E.* of charge Q accelerated with potential difference of U is given by

$K.E = QU$

magnetic moment = i × Area

$= \frac{Q}{T} \times \pi R^2$

Where T is time period of circular motion of charge Q and R is radius of circular motion

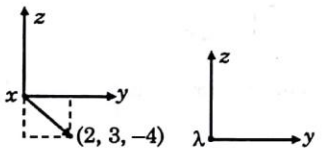
$$\therefore T = \frac{2\pi m}{QB}$$

$$R = \sqrt{\frac{2mKE}{QB}} = \sqrt{\frac{2mU}{QB}}$$

$$\text{Magnetic moment} = \frac{Q^2 \times B}{2\pi m} \times \frac{\pi \times 2m \times U}{Q^2 B^2}$$

Magnetic moment $\propto \frac{U}{B}$, so if U and B both are double magnetic moment remain unchanged.

27.[A]



Perpendicular distance of $A(0, 5, 12)$ from x axis $= r_1 = 13$ & $B(2, 3, -4)$ from x axis $= r_2 = 5$ and potential difference between these two point is $= \frac{\lambda}{2\pi \epsilon_0} \ln \frac{13}{5}$

$$V_B - V_A = \frac{\lambda}{2\pi \epsilon_0} \ln \frac{13}{5}$$

$$V_A = 0$$

$$\therefore V_B = \frac{\lambda}{2\pi \epsilon_0} \ln \frac{13}{5}$$

potential at $(2, 3, -4) = \frac{\lambda}{2\pi \epsilon_0} \ln \frac{13}{5}$

28.[C] For first half sample decay with process A of half lives $\frac{1}{2}$ hr.

$\therefore$ After first half hrs $N = N_0 \frac{1}{2}$

For next one hour decay process B of half lives $\frac{1}{4}$ hr occur

so for $t = \frac{1}{2}$ to $t = 1\frac{1}{2}$

Total 4 half lives occur

$$N = N_0 \frac{1}{2} \left[\frac{1}{2}\right]^4 = N_0 \left(\frac{1}{2}\right)^5$$

For last $\frac{1}{2}$ hr both A and B process occur simultaneously

for $t = 1\frac{1}{2}$ to $t = 2$hr

[For both A & $B \frac{1}{t_{1/2}} = \frac{1}{1/2} + \frac{1}{1/4} = 6$]

$$t_{1/2} = \frac{1}{6} \text{hr}$$

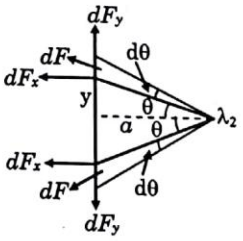
number of half life in $\frac{1}{2}$ hr is 3

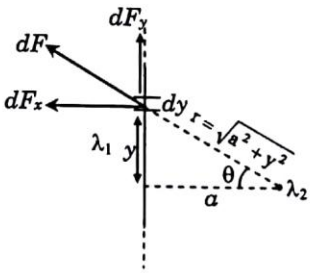
$$\therefore N = N_0 \left[\frac{1}{2}\right]^5 \left[\frac{1}{2}\right]^3$$

$$= N_0 \left[\frac{1}{2}\right]^8$$

$$a = 8$$

29.[C]





consider an element of thickness dy at distance y

charge on element $= dq = \lambda_1 dy$

E at the position of element $= E$

Force on element $= dF = dqE$

$$E = \frac{\lambda_2}{2\pi \epsilon_0 r} = \frac{\lambda_2}{2\pi \epsilon_0 \sqrt{a^2 + y^2}}$$

$$dF = \frac{\lambda_2 \times \lambda_1}{2\pi \epsilon_0 \sqrt{a^2 + y^2}} . dy$$

taking component of dF in x and y direction

By symmetry y component get cancel out

$dF_x = dF \cos\theta$

where $\cos\theta = \dfrac{a}{\sqrt{a^2 + y^2}}$

and $F_x = \int_{-\infty}^{+\infty} dF_x$

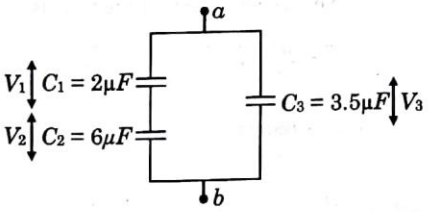
F_{net} is in direction of x-axis

$\therefore F_{net} = F_x$

$$F_x = \int_{-\infty}^{\infty} \frac{\lambda_1 \lambda_2 a}{2\pi \epsilon_0 (a^2 + y^2)} dy$$

$$\Rightarrow \frac{\lambda_1 \lambda_2}{2\pi \epsilon_0 a}$$

30.[B]



Let potential applied between a and $b = V$

using the formula

$$V_1 = \frac{\frac{1}{2}}{\frac{1}{2} + \frac{1}{6}} \times V$$

$$V_2 = \frac{\frac{1}{6}}{\frac{1}{2} + \frac{1}{6}} \times V$$

$$V_1 = \frac{6}{8} \times V = \frac{3}{4} V$$

$$V_2 = \frac{1}{4} V, V_3 = V$$

These voltage should be less than corresponding break down voltage

$$\left.\begin{array}{lll} \text{Now } \frac{3}{4} V < 100 & \Rightarrow V < \frac{400}{3} & \\ \frac{V}{4} < 50 & \Rightarrow V < 200V & V < \frac{400}{3} \\ V < 400 & \Rightarrow V < 400 & V < 133V \end{array}\right\} \text{common solution}$$

31.[D] ${}_0n^1 \rightarrow {}_1p^1 + {}_{-1}e^0 + \bar{\nu}$

The electron comes out with a spectrum of energies.

The energy released is shared between electron and neutrino.

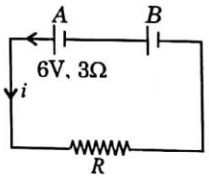
32.[C] Photo current $\propto$ intensity

$\therefore I_1 > I_2$

higher the frequency of light higher then stopping potential

$\therefore \upsilon_2 > \upsilon_1$

33.[A]



Current in the circuit is i and $i = \dfrac{\epsilon_{eq}}{R + r_{eq}}$

$\epsilon_{eq} = 6 + 6 = 12$, $r_{eq} = 3 + 2 = 5$

$$i = \frac{12}{R+5}$$

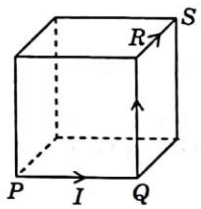
p.d across $A = 0$

$\epsilon_A - ir_A = 0$, where $\epsilon_A = 6V$ and $r_A = 3\,\Omega$

$$6 - \frac{12}{R+5} \times 3 = 0$$

$R = 1\Omega$

34.[C]



$F_{PQ} = 0 \Rightarrow F_{QR} = I\ell B$

$F_{RS} = I\ell B$

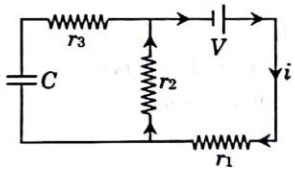
F_{QR} & F_{RS} are perpendicular to each other

$\therefore F_{net} = \sqrt{(I\ell B)^2 + (I\ell B)^2} = \sqrt{2} I\ell B$

35.[B] In steady state, the capacitor arm presents an infinite resistance.

$\therefore$ Current through that arm = 0

So the potential difference across C is that across r_2



Current through $r_2 = \dfrac{V}{r_1 + r_2}$

P.D. across $r_2 = \dfrac{Vr_2}{r_1 + r_2}$

P.D. across $C = \dfrac{Vr_2}{r_1 + r_2}$

36.[A] During motion force acting on particle only in downward direction i.e. mg so only its vertical velocity change during the motion

$a = \dfrac{mg}{m} = g$ downward

$v_y = u_y + gt$

$v_y - u_y = gt$

$\Delta v = gt = 10 \times 0.5 = 5$ m/sec

37.[B] Particle will strike the point B if velocity of particle with respect to platform is along AB or component of its relative velocity along AD is zero. i.e.,

Velocity of particle projected from A along $AD = u \cos\theta$

$\therefore u \cos\theta - v = 0$

$$u \cos\theta = v \text{ or } \theta = \cos^{-1}\left(\frac{v}{u}\right)$$

38.[A] Given that

$$\frac{dx}{dt} = \frac{dy}{dt} = c$$

$$\therefore \frac{d^2x}{dt^2}$$

$$\therefore \frac{d^2x}{dt^2} = \frac{d^2y}{dt^2} = 0$$

Further $z = ax^3 + by^2$

$$\therefore \frac{dz}{dt} = 3ax^2\frac{dx}{dt} + 2by\frac{dy}{dt}$$

$$= 3acx^2 + 2bcy \left(\frac{dx}{dt} = c = \frac{dt}{dt}\right)$$

$$\therefore \frac{d^2y}{dt^2} = 6acx\left(\frac{dx}{dt}\right) + 2bc\left(\frac{dy}{dt}\right)$$

$$= 6ac^2x + 2bc^2$$

Now acceleration of particle is

$$\vec{a} = \frac{d^2x}{dt^2}\hat{i} + \frac{d^2y}{dt^2}\hat{j} + \frac{d^2z}{dt^2}\hat{k}$$

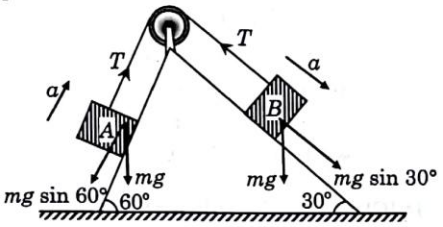
$$= (6ac^2x + 2bc^2)\hat{k}$$

39.[A] $\frac{3}{4}$th energy is lost i.e., $\frac{1}{4}$th kinetic energy is left. Hence, its velocity becomes $\frac{v_0}{2}$ under a retardation of μg in time t_0.

$$\therefore \frac{v_0}{2} = v_0 - \mu g\, t_0$$

$$\text{or } \mu g\, t_0 = \frac{v_0}{2} \text{ or } \mu = \frac{v_0}{2gt_0}$$

40.[A]



NLM on B $mg \sin 30° - T = m \times a$... (1)

$T - mg \sin 60° = ma$ ... (2)

$$a = \frac{mg \sin 60° - mg \sin 30°}{2m}$$

where a is Acceleration of system

Here, m = mass of each block

or $$a = \left(\frac{\sqrt{3}-1}{4}\right)g$$

acceleration of center of mass → a_{com}

Now $$\vec{a}_{com} = \frac{m\vec{a}_1 + m\vec{a}_2}{2m}$$

Here, $\vec{a}_1$ and $\vec{a}_2$ are $\left(\frac{\sqrt{3}-1}{4}\right)g$ at right angles.

Hence, $$|\vec{a}_{com}| = \frac{\sqrt{2}}{2}a = \left(\frac{\sqrt{3}-1}{4\sqrt{2}}\right)g$$

CHEMISTRY

41.[D] B like S^{2-} (making hcp)

A like Zn^{2+} (alternate tetrahedral void)

X (alternate octahedral void)

no. of B in one unit cell = 6

no. of A in one unit cell = $\frac{1}{2} \times 12 = 6$

no. of X in one unit cell = $\frac{1}{2} \times 6 = 3$

⇒ Formula $A_6B_6X_3 \Rightarrow A_2B_2X$

∵ A is in tetrahedral void, so, coordination number is 4.

∵ X is in octahedral void, so, coordination number is 6.

when alternate tetrahedral voids are occupied, then centres of 6A atoms lies on the edges of one unit cell.

42.[B] $XeF_5^- < XeF_4 < XeF_2$

43.[C]

Solute	y	x	i = [1 + (y – 1) x]
(A) KCl	2	0.5	1.5
(B) K_2SO_4	3	0.4	1.8
(C) $FeCl_3$	4	0.3	1.9
(D) $SnCl_4$	5	0.2	1.8

44.[C] (A) $\underset{M}{\overset{+}{N}=\overset{+}{N}=N}$ Four membered ring is not stable.

(B) Both N–N bond lengths are identical and that is 1.15 Å

(C) N_3^- and CO_2 both have same number of electrons i.e. 22; so isoelectronic.

$N^- = \underset{sp}{\overset{+}{N}} = N^-$ (linear) $O = \underset{sp}{C} = O$(linear)

So, both are also isostructural

(D) There are two σ and two π bonds.

$:\overset{2-}{\underset{\cdot\cdot}{N}}-\overset{+}{N}\equiv N: \leftrightarrow :\underset{\cdot\cdot}{N}-\overset{+}{\underset{\cdot\cdot}{N}}\equiv\overset{2-}{\underset{\cdot\cdot}{N}}: \leftrightarrow :\underset{\cdot\cdot}{\overset{-}{N}}=\overset{+}{\underset{\cdot\cdot}{N}}=\underset{\cdot\cdot}{\overset{-}{N}}:$

45.[C] This process is simply calcinations.

46.[A] $Na_2[Cr(edta)]$ is correct representation.

47.[D] FFT

48.[A] For strong electrolytes

$$\wedge_m = \wedge_m^0 - b\sqrt{c}$$

$$\text{dilution} = \frac{1}{\text{concentration}}$$

49.[A] In excess of NH_4OH ppt of $Zn(OH)_2$ will get dissolved.

50.[D] A,B and C are correctly matched.

(D) tetrahedral, CO stronger ligand, so pairing of electrons occurs.

51.[C] (A) At concentration slightly lesser than CMC, all molecules are present separately.

Above CMC, they form micelles. Number of micelles is less than no. of detergent molecules.

So concentration of micelles is less. Hence entropy decreases.

(B) Molecular masses of proteins are high as they are polymers. Hence, for same mass of protein and urea in different solution, concentration of urea will be more. So vapor pressure will be more for protein solution. Also, this can be explained in terms of entropy.

(C) Entropy of pure solid solvent

< entropy of pure liquid solvent.

< entropy of liquid solution of non volatile solute.

(D) Coagulation means combining together of colloid particles to give precipitate. In this process, obviously entropy decreases.

52.[B]

	A	+	$2B \longrightarrow$ product
at $t = 0$	a		a
at $t = 0$	$a - x$		$a - 2x$

$[A]_t = ae^{-kt}$

$a - x = ae^{-kt} \Rightarrow x = a(1 - e^{-kt})$

at $t = t_1$ $\quad a - x = \frac{a}{2}$

$x = \frac{a}{2}$

$[B_t] = a - 2x$

$= a - 2a(1 - e^{-kt})$

$= a(2e^{-Kt} - 1)$

at $t = 0$ $\quad [B] = a$

at $t = t_{1/2}$ of a, $[B_t] = a - 2x$

$= a - a$

$= 0$

Only graph (b) matches this.

53.[D] Kw at 90°C is 10^{-12}

Hence, Neutral point is 6

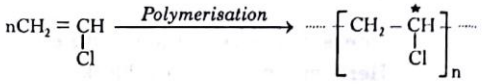
So, on adding pH = 2 (10^{-2} H^+)

and pH = 10 (10^{-2} OH)

Solution lead to the formation of neutral solution i.e. pH = 6

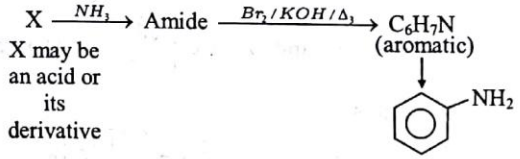
54.[C] Propanal and Benzaldehyde

55.[C] PVC = Polyvinylchloride has asymmetric C* atoms



56.[C] Oxidation by heating with copper followed by reaction with I_2 / $OH^{\ominus}$

57.[D]



58.[B] x = 1.532 Å y = 1.549 Å C – H = 1.09 Å

59.[C] IV > I > III > II

60.[C] III > II > I

BIOLOGY

61.[A] Smooth muscles

62.[B] Lactic acid deposit in muscle

63.[B] Coxa, trochanter, femur, tibia and tarsus

64.[D] In polycythemia R.B.Cs are increased in number by amitotic division

65.[B] Penis in male and cervix and vagina in female

66.[C] Secretions of acrosome helps one sperm enter cytoplasm of ovum through zone pellucida

67.[D] On the cell surface

68.[B] Estrous phase

69.[D] Corynebacteria

70.[C] non-steroidal preparation

71.[A] Genetic drift

72.[A] Evidences from biogeographical distribution

73.[C] Convergent evolution

74.[B] Prion

75.[C] abundant fibres

76.[B] *Marchentia*

77.[C] Heterosporous and dioecious

78.[C] The outermost glycocalyx is followed by cell wall and plasma membrane

79.[D] I, II and III

80.[D] Is found most abundantly

PART-II [Two Marks Questions]

MATHEMATICS

81.[D] $y = 1 \Rightarrow f(x) = f(1)^x$ i.e. $f(x) = k^x$

82.[D] $f(x) = (3 - x^7)^{1/7}$

$f(f(x)) = (3 - (f(x))^7)^{1/7} = [3 - ((3 - x^7)^{1/7})^7]^{1/7} = x$

$f^{-1}(x) = f(x)$

$\therefore f^{-1}(50) = f(50)$ and $f(f(100)) = 100$

83.[A] $S_n = 1 + \dfrac{1-\left(\frac{1}{2}\right)^3}{1-\frac{1}{2}} + \dfrac{1-\left(\frac{1}{2}\right)^5}{1-\frac{1}{2}} + \ldots\ldots n \text{ terms}$

$= 1 + 2\left(1-\left(\frac{1}{2}\right)^3\right) + 2\left(1-\left(\frac{1}{2}\right)^5\right) + \ldots. n$ times $= 1 + (2 + 2 + \ldots. (n-1) \text{ times}) - \left[\left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^4 + \ldots\ldots (n-1) \text{ times}\right]$

$= 1 + 2(n-1) - \dfrac{(1/2)^2}{1-\left(\frac{1}{2}\right)^2}\left(1-\left(\frac{1}{2}\right)^{2(n-1)}\right)$

$= 2n - 1 - \dfrac{1}{3} + \dfrac{4}{3.2^{2n}} = 2n - \dfrac{4}{3}\left(1 - \dfrac{1}{2^{2n}}\right)$

84.[C] $t_n = \dfrac{n}{1.3.5\ldots\ldots(2n+1)}$

$= \dfrac{1}{2}\dfrac{(2n+1)-1}{1.3.5\ldots\ldots(2n+1)}$

$= \dfrac{1}{2}\left[\dfrac{1}{1.3.5\ldots\ldots(2n+1)} - \dfrac{1}{1.3.5\ldots\ldots(2n+1)}\right]$

$= \dfrac{1}{2}(T_{n-1} - T_n)$

$\therefore 2t_n = T_{n-1} - T_n$ ....(i)

$\left(\text{where } T_n = \dfrac{1}{1.3.5\ldots\ldots(2n+1)}\right)$

$2S_n = \sum_{n=2}^{n} 2t_n + 2t_1$

$= (T_1 - T_2) + (T_2 - T_3) + \ldots + T_{n-1} - T_n + 2t_1$

$\Rightarrow 2(S_n - t_1) = T_1 - T_n \Rightarrow 2S_n = 2t_1 + T_1 - T_n$

$\Rightarrow 2S_n = 2.\ \dfrac{1}{1.3} + \dfrac{1}{1.3} - \dfrac{1}{1.3.5\ldots\ldots(2n+1)}$

$\Rightarrow S_n = \dfrac{1}{2}\left[1 - \dfrac{1}{1.3.5\ldots\ldots(2n+1)}\right]$

85.[A] $9x^3 - 9x^2 - x + 1 = 0$

$\Rightarrow (x-1)(9x^2-1) = 0$

$\Rightarrow x = 1, \pm\frac{1}{3}$

$\cos\alpha = 1 \Rightarrow \alpha = 0$

$\cos\beta = 1/3 \Rightarrow \beta = \cos^{-1} 1/3$

$\cos\gamma = 1/3 \Rightarrow \gamma = \pi - \cos^{-1} 1/3$

$\Sigma\alpha = \pi, \Sigma\cos\alpha = 1$

$\therefore$ centre is $(\pi, 1)$

$\therefore$ equation of the circle is

$(x-\pi)^2 + (y-1)^2 = r^2$

Which passes through

$(2\sin^{-1}\left(\tan\frac{\pi}{4}\right), 4) \equiv (\pi, 4)$

$\therefore \quad 0 + 9 = r^2 \Rightarrow r = 3$

86.[C] $YP.\ YB = YZ.\ YQ$

$YA.\ YP = YX.\ YQ$ take ratio

But $YA = YB$

hence $XY = YZ$

87.[A] $\frac{8^x + 27^x}{12^x + 18^x} = \frac{7}{6}$

$\frac{(8)^x}{(12)^x}\frac{(1+(27/8)^x)}{(1+(18/12)^x)} = \frac{7}{6}$

$\Rightarrow \left(\frac{2}{3}\right)^x\left(\frac{1+(3/2)^{3x}}{1+(3/2)^x}\right) = \frac{7}{6}$

Let $\left(\frac{3}{2}\right)^x = t$

$\Rightarrow \frac{1+t^3}{t(1+t)} = \frac{7}{6} \qquad \because t+1 \neq 0$

$\frac{(1+t)(t^2+1-t)}{t(1+t)} = \frac{7}{6}$

$\Rightarrow \frac{t^2+1-t}{t} = \frac{7}{6}$

$\Rightarrow t = \frac{2}{3}$ or $\frac{3}{2}$

88.[B] $\sqrt{3}\sin x - \cos x = \min_{\lambda\in R}\{2, e^2, \pi, \lambda^2 - 4\lambda + 7\}$

Let $B = \lambda^2 - 4\lambda + 7$

$= \lambda^2 - 2.2\lambda + 4 + 3$

$= (\lambda - 2)^2 + 3$

$B_{min.} = 3$

$\therefore \sqrt{3}\sin x - \cos x = 2$

$\frac{\sqrt{3}}{2}\sin x - \frac{1}{2}\cos x = 1$

$\Rightarrow \sin x.\cos\frac{\pi}{6} - \cos x.\sin\frac{\pi}{6} = 1$

$\sin(x - \frac{\pi}{6}) = 1$, So $x - \frac{\pi}{6} = 2n\pi + \frac{\pi}{2}$

$x = 2n\pi + \frac{\pi}{2} + \frac{\pi}{6} = 2n\pi + \frac{2\pi}{3}$

89.[B] $2\vec{u} - \vec{v} = \vec{w}$

$(2x + 2y - 4)\vec{a} + (-3x + 4y + 2)\vec{b} = 0$

$\Rightarrow 2x + 2y - 4 = 0$ and $-3x + 4y + 2 = 0$

$\Rightarrow x = 10/7, y = 4/7$

90.[A] Given equation can be written as

$x^4\cos y\frac{dy}{dx} + 4x^3\sin y = xe^x$

$\Rightarrow \frac{d}{dx}(x^4\sin y) = xe^x$

$\Rightarrow x^4\sin y = \int xe^x\,dx$

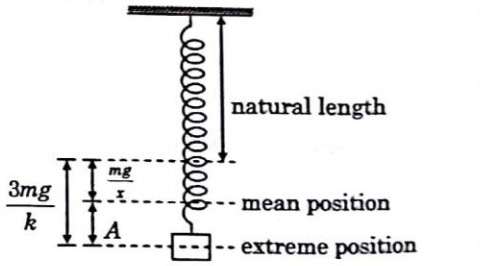
$\Rightarrow x^4\sin y = (x-1)e^x + c$

But when $x = 1, y = 0$ so $c = 0$

Hence required solution is $\sin y = x^{-4}(x-1)e^x$

PHYSICS

91.[B] Just after cutting the string extension in spring $= \frac{3mg}{k}$

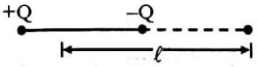


The extension in the spring when block is in mean position $= \frac{mg}{k}$

$\therefore$ Amplitude of oscillation

$A = \frac{3mg}{k} - \frac{mg}{k} = \frac{2mg}{k}$.

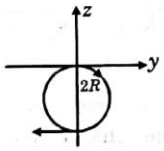
92.[B] The two plates acts as a dipole



$\therefore$ Force on charge q ;

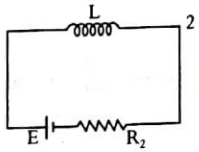
$$F = Eq = \left(\frac{2kQd}{\ell^3}\right) . q = \frac{Qqd}{2\pi\varepsilon_0\ell^3} .$$

93.[D] Radio of projection of helix will be $r = \frac{v_0}{\alpha B_0}$ and time period of projection will be $T = \frac{2\pi}{\alpha B_0}$, projected circle will be formed on y–z plane. It will make half circle in time $t = \frac{\pi}{B_0\alpha}$.



x–coordinate = $\upsilon_0 t = \upsilon_0 . \frac{\pi}{B_0\alpha}$.

94.[A] When the key is at position (2) for a long time; the energy stored in the inductor is:



$$U_B = \frac{1}{2} Li_0^2 = \frac{1}{2} .L. \left(\frac{E}{R_2}\right)^2 = \frac{L.E.^2}{2{R_2}^2}$$

This whole energy will be dissipated in the form of heat when the inductor is connected to R_1 and no source is connected.

95.[C] $i = 3 \sin \omega t + 4 \cos \omega t$

$$= 5\left[\frac{3}{5}\sin \omega t + \frac{4}{5}\cos \omega t\right]$$

$$= 5[\sin(\omega t + \delta)] \quad \ldots(1)$$

$\Rightarrow$ rms value $= \frac{5}{\sqrt{2}}$

$$\Rightarrow \text{mean value} = \frac{\int_{T_1}^{T_2} i dt}{\int_{T_1}^{T_2} dt}$$

$\therefore$ Initial value is not given hence the mean value will be different for various time intervals.

If voltage applied is $V = V_m \sin\omega t$ then i given by equation (1) indicated that it is ahead of V by δ where $0 < \delta < 90$ which indicates that the circuit contains R & C.

Hence (C).

96.[A] Number of photons incident on sphere per second $= \frac{IA}{h\nu}$

$\therefore$ photo electrons ejected per second

$d = \frac{IA}{h\nu}$

$\therefore$ current through conducting wire = photo current

ejected from surface of sphere $= \frac{IAe}{h\nu}$

97.[B] $V = KT + C$

$$P = \frac{nRT}{V} \Rightarrow P = \frac{mRT}{KT + C}$$

$$\frac{dP}{dT} = \frac{nRC}{(KT + C)^2}$$

As $C < 0$ by diagram

$\Rightarrow \frac{dP}{dT} < 0$ for all T

$\Rightarrow P$ continuously decreases.

98.[B] $A = 90 - \theta$

$r_2 = A = 90 - \theta > \theta_C$

$\cos\theta > \sin\theta_C = \frac{6/5}{3/2} = \frac{4}{5}$

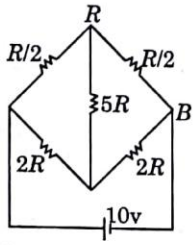
$\Rightarrow \theta < \cos^{-1}\frac{4}{5} = 37°$.

99.[B] $T = \frac{2\pi m}{qB}$, $p = \frac{2\pi m}{qB} v\cos\theta$, $R = \frac{mv\sin\theta}{qB}$

$$a = \frac{\cos\theta_1}{\cos\theta_2}, \; b = \frac{\sin\theta_1}{\sin\theta_2}, \; c = 1$$

$$a = \sqrt{3}, \; b = \frac{1}{\sqrt{3}}, \; c = 1.$$

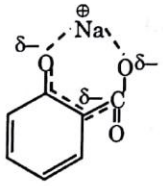
100.[A]



It is a balanced wheat stone bridge,
So, $V_A - V_B = 5V$

CHEMISTRY

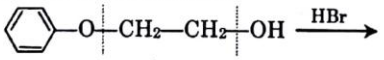
101.[D]



$K^{\oplus}$ cation is larger and is likely to be less effective in chelation. So that attack on the *p*-position.
When NaOH is used then dianion formed in Kolbe-Schmidt reaction is stabilize by Na^+ which is not possible for K^+ ion.

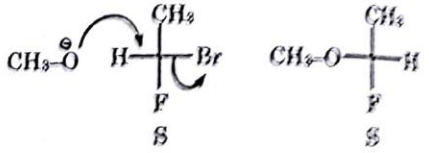
102.[A] In acetylation reaction one acidic H is replace by $-\overset{\overset{O}{\|}}{C}-CH_3$ group and molecular mass increased by – 42 with each H replacement. Total mass increase is 84 So 2 – OH group.

103.[C] Double bond character



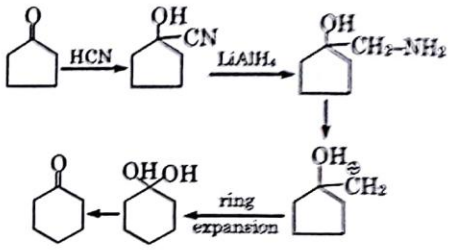
$$Ph - OH + \begin{matrix} CH_2 - Br \\ | \\ CH_2 - Br \end{matrix}$$

104.[C] Statement-I is false Statement-II is true



R to *S* when highest replaced by higher. Although configuration always changes

105.[A]



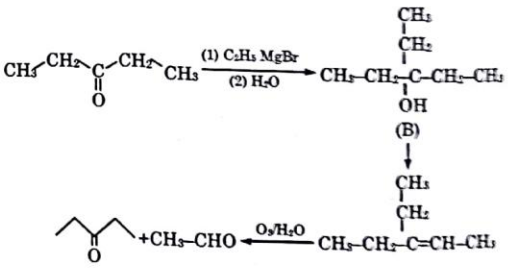
106.[A] Rate of nucleophilic addition reaction

$\propto$ +ve the charge on carbonyl c-atom

$$\propto \frac{1}{steric repulsium}$$

Reacitivity of Aldehyde > Ketone > Aromatic Ketone

107.[B]



108.[B] Same magnetic moment = Same number of unpaired electrons = $\sqrt{n(n+2)}$

where n = number of unpaired electrons

$Co^{2+} = 3d^7$, 3 unpaired electrons

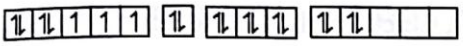
$Cr^{2+} = 3d^4$, 4 unpaired electrons

$Mn^{2+} = 3d^{+5}$, 5 unpaired electrons

$Co^{3+} = 3d^6$, 4 unpaired electrons

109.[C]

$[Fe(H_2O)_5\overset{1}{N}O]^{+}$



Number of unpaired electrons

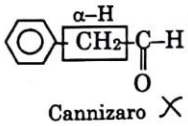
= 3; So $\mu = \sqrt{3(2+3)} = 3.87$ B.M.

Brown colour is due to charge transfer from ligand to metal

110.[D] For Cannizaro reaction, α hydrogen must absent

(A) $CH_3\overset{\alpha}{\boxed{CH_2}}-\underset{\underset{O}{\|}}{C}-H$ Cannizaro ✗

(B) $CH_3-\underset{\underset{O}{\|}}{C}-\boxed{CH_3}$ α H Cannizaro ✗

(C)  Cannizaro ✗

(D) $CH_3-\overset{CH}{\underset{|}{CH}}-\underset{\underset{O}{\|}}{C}-H$

It is a special case which can give Cannizaro reaction although contain α–H

BIOLOGY

111.[D] Up hill transport of proton across inner membrane of mitochondria is due to active transport during ETS.

112.[D] 1 : 1

113.[A] 5'-AUG CUG GUG CAB3'

114.[C] Secondary consumer as well as producer

115.[B] Mesocarp

116.[C] Neural response

117.[A] Both placenta as well as fully developed foetus

118.[C] Survival of the fittest

119.[B] Na^+ ions are helpful to conserving water in the body.

120.[B] disappear

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-6

Stream – SX

Hints & Solutions

Answer key

1.(C)	2.(A)	3.(C)	4.(D)	5.(D)	6.(C)	7.(B)	8.(B)	9.(B)	10.(D)	11.(B)	12.(A)	13.(D)	14.(B)
15.(B)	16.(A)	17.(C)	18.(B)	19.(D)	20.(B)	21.(A)	22.(C)	23.(B)	24.(C)	25.(B)	26.(C)	27.(B)	28.(D)
29.(B)	30.(A)	31.(B)	32.(C)	33.(D)	34.(D)	35.(D)	36.(A)	37.(D)	38.(B)	39.(A)	40.(D)	41.(D)	42.(B)
43.(C)	44.(C)	45.(C)	46.(A)	47.(D)	48.(A)	49.(A)	50.(D)	51.(C)	52.(B)	53.(D)	54.(C)	55.(C)	56.(C)
57.(D)	58.(B)	59.(C)	60.(C)	61.(B)	62.(C)	63.(C)	64.(C)	65.(B)	66.(B)	67.(B)	68.(C)	69.(C)	70.(A)
71.(C)	72.(C)	73.(A)	74.(A)	75.(A)	76.(D)	77.(A)	78.(D)	79.(A)	80.(A)	81.(A)	82.(C)	83.(B)	84.(A)
85.(D)	86.(A)	87.(D)	88.(B)	89.(B)	90.(B)	91.(B)	92.(B)	93.(D)	94.(A)	95.(C)	96.(A)	97.(B)	98.(B)
99.(B)	100.(A)	101.(B)	102.(C)	103.(D)	104.(D)	105.(B)	106.(A)	107.(A)	108.(C)	109.(A)	110.(B)	111.(D)	112.(D)
113.(A)	114.(C)	115.(B)	116.(A)	117.(A)	118.(A)	119.(C)	120.(D)						

PART-I [One Mark Questions]

MATHEMATICS

1.[C] $f'(x) = \cos\left(\frac{x^2+2x+1}{5}\right) = \cos\left(\frac{(x+1)^2}{5}\right)$

Since, $0 \le x \le 2$, $\frac{1}{5} \le \frac{(x+1)^2}{5} \le \frac{9}{5}$

$\cos\frac{(x+1)^2}{5} = 0$,

only when $\frac{(x+1)^2}{5} = \frac{\pi}{2}$

$f'(x) > 0$, if $0 < x < \sqrt{\frac{5\pi}{2}} - 1$

$f'(x) < 0$, if $\sqrt{\frac{5\pi}{2}} - 1 < x < 2$

$\therefore x = \sqrt{\frac{5\pi}{2}} - 1$ is a point of local maximum.

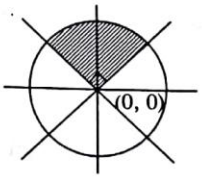
2.[A] Correct mean $= \frac{300-(3+6)+(8+4)}{20} = 15.15$

3.[C] $\int_0^{2/3} f(x)\,dx$

$$\int_0^{2/3}\left([x]+\left[x+\frac{1}{3}\right]+\left[x+\frac{2}{3}\right]\right)dx$$

$$= \int_0^{1/3} 0\,dx + \int_{1/3}^{2/3} dx = \frac{2}{3} - \frac{1}{3} = \frac{1}{3}$$

4.[D] $x^2 + y^2 \le 16$ & $|x| \ge y$



(unshaded) Area $= \frac{3}{4} \times \pi \times 4^2 = 12\pi$

5.[D] $|adj(adj.(adjA))| = |adj\,A|^{(n-1)^2}$

$= |A|^{(n-1)^3} = 2^{27}$

6.[C] $D > 0\ ;\ \alpha\beta > 0\ ;\ \alpha + \beta < 0 \Rightarrow \alpha < 0\ ;\ \beta < 0$

$$\therefore \cot^{-1}\alpha + \cot^{-1}\left(\frac{1}{\alpha}\right) - \frac{\pi}{2}$$

$$= \cot^{-1}\alpha + \pi + \tan^{-1}\alpha - \frac{\pi}{2}$$

$$= \pi + \frac{\pi}{2} - \frac{\pi}{2} = \pi$$

7.[B] $\alpha + \beta = -b/a$ & $\alpha\beta = c/a$

Then $(1 + \alpha + \alpha^2)(1 + \beta + \beta^2)$

$= 1 + (\alpha+\beta) + (\alpha\beta) + (\alpha\beta)^2 + (\alpha^2+\beta^2) + \alpha\beta(\alpha+\beta)$

$$= 1 - \frac{b}{a} + \frac{c}{a} + \frac{c^2}{a^2} + \frac{b^2}{a^2} - \frac{2c}{a} - \frac{bc}{a^2}$$

$$= \frac{a^2 - ab + ac + c^2 + b^2 - 2ac - bc}{a^2}$$

$$= \frac{a^2 + b^2 + c^2 - ab - bc - ac}{a^2}$$

$$= \frac{(2a^2 + 2b^2 + 2c^2 - 2ab - 2bc - 2ac)}{2a^2}$$

$$= \frac{(a-b)^2 + (b-c)^2 + (a-c)^2}{2a^2} > 0$$

8.[B] Let $N^r = f(x) = x^3 + (a-10)x^2 - x + a - 6 = 0$ has roots α, β, γ

& $D^r = g(x) = x^3 + (a-6)x^2 - x + a - 10 = 0$ has roots α, β, ρ

$\therefore\ f(x) - g(x) = -4x^2 + 4 = 0 \Rightarrow x = \pm 1$

$\therefore\ \alpha + \beta = 0,\ \alpha\beta = -1$

$\therefore\ \alpha + \beta + \gamma = -(a-10) = 10 - a$

$\Rightarrow\ \gamma = 10 - a$ ....(i)

$\alpha\beta\gamma = 6 - a \Rightarrow\ \gamma = a - 6$ ....(ii)

from (i) & (ii)

$10 - a = a - 6$

$a = 8$

9.[B] $\because\ \cos^{-1}\cos x = \cos^{-1}\cos(2\pi - x)$

for $x \in \left(\frac{3\pi}{2}, 2\pi\right) = 2\pi - x$

$\sin^{-1}\sin x = x - 2\pi$

$\therefore\ \sin^{-1}(\cos(\cos^{-1}(\cos x) + \sin^{-1}(\sin x)))$

$= \sin^{-1}(\cos 0) = \sin^{-1}(1) = \frac{\pi}{2}$

10.[D] $1 < 2^{(-r+3^{-a})} < 2$

$a = \log_3\log_3 2 \Rightarrow 3^a = \log_3 2 \Rightarrow 3^{-a} = \log_2 3$

$0 < -r + 3^{-a} < 1\ \log_2 3 - r > 0 \Rightarrow \log_2 3 > r$,

$\log_2 3 < 1 + r$

$1 < \log_2 3 < 2 \Rightarrow\ r = 1$

11.[B] $\because\ x! - (x-1)! \neq 0 \Rightarrow x \in I^+ - \{1\}$

$2^{\pi/\tan^{-1}x} - 4 > 0$ as $\tan^{-1}x < \pi/2$

$$\therefore\ \frac{(x-4)(x-10)}{(x-1)!\,(x-1)} < 0$$

$\therefore\ x \in \{5, 6, 7, 8, 9\}$

12.[A] $$2b = \frac{a+b}{1-ab} + \frac{b+c}{1-bc}$$

$\Rightarrow 2ab^3c + 2abc = a + c + ab^2 + b^2c$

$\Rightarrow 2abc\,(b^2+1) = (a+c)(1+b^2)$

$$\Rightarrow 2b = \frac{a+c}{ac} \Rightarrow 2b = \frac{1}{a} + \frac{1}{c}$$

$\Rightarrow a^{-1}, b, c^{-1}$ are in A.P.

13.[D] $\because$ A is centre of circle (as shown in figure) because chord CD & BC subtends twice the angle at A w.r.t. point B & D respectively.

$$\therefore \angle ABE = \angle ADE = \frac{180° - 110°}{2} = 35°$$

$\therefore\ \angle AEB = 180° - (50° + 35°) = 95°$

14.[B] $\sin^3\theta + \sin\theta\cos\theta + \cos^3\theta = 1$

$(\sin\theta + \cos\theta)(1 - \sin\theta\cos\theta) + \sin\theta\cos\theta - 1 = 1$

$(1 - \sin\theta\cos\theta)(\sin\theta + \cos\theta - 1) = 0$

$\Rightarrow \sin\theta\cos\theta = 1$ or $\sin\theta + \cos\theta = 1$

$$\Rightarrow \sin 2\theta = 2 \text{(not true) or } \cos\left(\theta - \frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$$

$$\theta - \frac{\pi}{4} = 2n\pi \pm \frac{\pi}{4} \Rightarrow \theta = 2n\pi \text{ or } \theta = 2n\pi + \frac{\pi}{2}$$

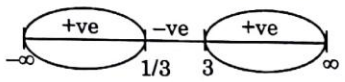
15.[B] $$y = \frac{3\tan x - \tan^3 x}{(1 - 3\tan^2 x)\tan x}$$

$$y = \frac{3 - \tan^2 x}{1 - 3\tan^2 x}$$

$$\tan^2 x = \frac{3-y}{1-3y}$$

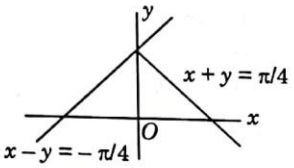
If $\tan^2 x \geq 0$

$$\frac{3-y}{1-3y} \geq 0$$



Never lies between $\frac{1}{3}$ and 3.

16.[A] $a = 0$



equation $x + y = \frac{\pi}{2} - \frac{\pi}{4} \Rightarrow x + y = \frac{\pi}{4}$

image $x - y + \frac{\pi}{4} = 0$

17.[C] Since, $0 \le arg\ (z) \le \frac{\pi}{4}$, represent the region of complex plane lying in the first quadrant and bounded by x-axis and the line $y = x$.

$|2z - 4i| = 2|z - 2i|$

Least value of $|z - 2i|$ is length of perpendicular from (0, 2) to $y = x$, which is $\sqrt{2}$.

So, the least value of $\sqrt{2}\ |2z - 4i|$ is 4.

18.[B] Let, $\vec{c} = x\hat{i} + y\hat{j}$

$\Rightarrow \quad \vec{b} \perp \vec{c}$

$\therefore \quad \frac{x}{3} = \frac{y}{-4} = \lambda \Rightarrow \vec{c} = \lambda(3\hat{i} - 4\hat{j})$

Let the required vector be $= \vec{\alpha} = p\hat{i} + q\hat{j}$

$\frac{\vec{\alpha}.\vec{b}}{|\vec{b}|} = 1\ ;\ \frac{\vec{\alpha}.\vec{c}}{|\vec{c}|} = 2$

$4p + 3q = 5\ ;\ 3p - 4q = 10$

$p = 2,\ q = -1$

$\vec{\alpha} = 2\hat{i} - \hat{j}$

19.[D] $2\vec{a} - 3\vec{b} + 4\vec{c}$

$= (\lambda_1 - \lambda_2 + \lambda_3)\vec{a} + (-\lambda_1 + \lambda_2 - \lambda_3)\vec{b} + (\lambda_1 + \lambda_2 + \lambda_3)\vec{c}$

Now $\lambda_1 - \lambda_2 + \lambda_3 = 2$,

$-\lambda_1 + \lambda_2 - \lambda_3 = -3 \Rightarrow \lambda_1 - \lambda_2 + \lambda_3 = 3$

Clearly, these two condition can't be true together

So $\lambda \in \phi$

20.[B] Writing the given equation as

$\frac{dy}{dx} = \frac{y + \sqrt{x^2 + y^2}}{x}$ and putting $y = vx$,

we have $v + x\frac{dv}{dx} = v + \sqrt{1 + v^2}$

$\Rightarrow \frac{dv}{\sqrt{1 + v^2}} = \frac{dx}{x}$

Integrating, we have

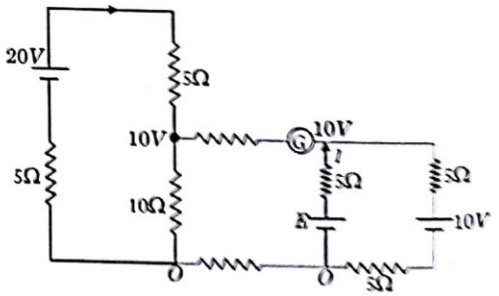
$\log (v + \sqrt{1 + v^2}) = \log x + \text{constant}$

$\Rightarrow y/x + \sqrt{1 + (y^2/x^2)} = Cx$

$\Rightarrow y + \sqrt{x^2 + y^2} = Cx^2$

PHYSICS

21.[A] $\frac{E - 10}{20} = I$



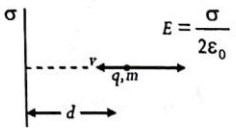
$10 = E - \frac{E - 10}{20} \times 5$

$40 = 4E - E + 10$

$30 = 3E$

$E = 10\ V.$

22.[C] $E = \frac{\sigma}{2\varepsilon_0}$: $F = \frac{\sigma q}{2\varepsilon_0}$



$a = \frac{\sigma}{2\varepsilon_0 m}$ $\qquad v^2 = u^2 + 2as$

$0^2 = v^2 + 2\left(\frac{\sigma q}{2\varepsilon_0 m}\right)d \Rightarrow v = \sqrt{\frac{\sigma q d}{\varepsilon_0 m}}$

23.[B] the magnet rotates clockwise as seen by observer from below

24.[C] Just before collision and just after collision, direction of momentum vector is opposite and speed decreases for each collision.

25.[B] Q will be at higher potential than P.

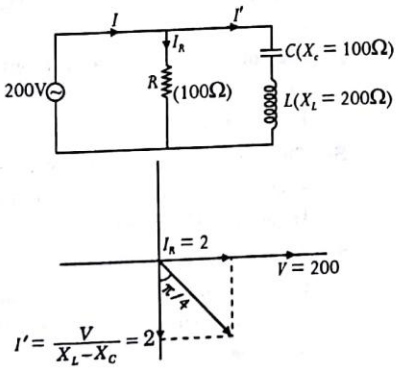
26.[C] After two and half time periods, it is at a distance $2R_0$ on the negative z-axis. Y-coordinate will be zero.

And the x-coordinate = $2.5\ P_0$.

i.e. it is at a distance $7.5\ P_0$ from the mirror, hence its image will be at $2(7.5\ P_0) + 2.5\ P_0 = 17.5\ P_0$.

Hence (C).

27.[B]



$I_R = \frac{V}{R} = \frac{200}{100} = 2\text{A}$

$I' = \frac{V}{X_L - X_C} = \frac{20}{10} = 2\text{A}$

$I = \sqrt{I_R^2 + I'^2} = 2\sqrt{2}$ Amp.

28.[D] $I = I_0 + I_0 + 2I_0 \cos f$

$I_{max} = (\sqrt{I_0} + \sqrt{I_0})^2 = 4\ I_0$

$I = 0.75\ I_{max} = 3\ I_0$

So, $3I_0 = I_0 + I_0 + 2I_0 \cos f$

$\cos f = \frac{1}{2}$

$f = \frac{\pi}{3}, 2\pi - \frac{\pi}{3}, 2\pi + \frac{\pi}{3}, 4\pi - \frac{\pi}{3}$

$f = \frac{\pi}{3}, \frac{5\pi}{3}, \frac{7\pi}{3}, \frac{11\pi}{3}, \ldots.$

path difference $Dx = \frac{\lambda}{2\pi}\phi = (m - 1)t$

$t = \frac{0.6}{\pi}\phi\mu m$

= 0.2 mm, 1.0 mm, 1.4 mm, 2.2 mm.

29.[B] $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$

$\Rightarrow \frac{h}{\sqrt{2m(Vq)}}$

$\therefore$ For higher m and q;
λ will be smaller.

For an 'α' particle; both 'm' and 'q' are higher

Hence lesser is the wavelength.

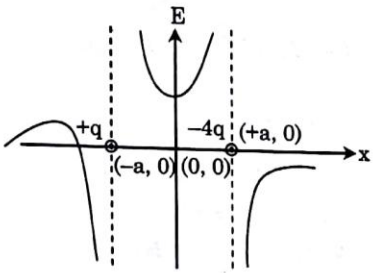
As, (penetrating power) $\propto$ Energy $\propto \frac{1}{\lambda}$

From above; penetrating power of an α-particle is more than that of a proton.

30.[A] Cut-off wavelength of emitted X-rays depends on maximum kinetic energy of incident electrons on the target and is independent of nature of target. The characteristic lines depend on nature of material of target.

31.[B] Released energy = $140 \times 7 + 8 \times 40 - 180 \times 6$
$= 980 + 320 - 1080$
$= 220$ MeV.

32.[C]



33.[D] $I_{max} = \dfrac{2\varepsilon}{R}$ at $t = 0$

$I = \dfrac{\varepsilon}{R}$ at $t = \infty$

So, charge on the capacitor is $C\varepsilon$, when current is 50% of maximum current.

34.[D] $A_1/A_2 = K_2/K_1$

35.[D] For waves along a string :

$\upsilon \propto \sqrt{T}$

$\Rightarrow \lambda \propto \sqrt{T}$

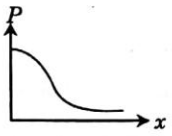
Now, for 6 loops : $3\lambda_1 = L \Rightarrow \lambda_1 = L/3$

& for 4 loops $2\lambda_2 = L \Rightarrow \lambda_2 = L/2$

$\Rightarrow \dfrac{\lambda_1}{\lambda_2} = \dfrac{2}{3} \Rightarrow T_2 = \dfrac{9}{4} \times T_1 = \dfrac{9}{4} \times 36$

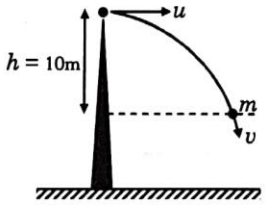
$= 81$ N.

36.[A]



37.[D] $\vec{a} + 2\vec{c} = 3\vec{b}$

38.[B] The pebble is at same distance from top and base of the tower after it falls down by a distance $h = 10$ m.
Applying conservation of energy.



$\dfrac{1}{2}mv^2 = \dfrac{1}{2}mu^2 + mgh$

or $v^2 = u^2 + 2gh = 100 + 2 \times 10 \times 10 = 300$

$\therefore \quad v = 10\sqrt{3}$ m/s.

39.[A] Let the body have temperatures T_1 and T_2 respectively at wavelength $\lambda_1 = 8000$Å and $\lambda_2 = 4000$Å.

$\therefore$ From Wien's displacement law

$\lambda T =$ constant

$\Rightarrow \lambda_1 T_1 = \lambda_2 T_2$ or $8000 \times T_1 = 4000 T_2$

or $\dfrac{T_1}{T_2} = \dfrac{1}{2}$

Emissive power $= e\sigma AT^4$

$\therefore$ Ratio of emissive powers at these temperature is

$$= \frac{e_1 T_1^4}{e_2 T_2^4} = \frac{0.5}{0.8} \times \left(\frac{1}{2}\right)^4 = \frac{5}{128}$$

40.[D] **S₁ :** A charged body induces charges on an uncharged conductor and as a result both attract each other. Hence true

S₂ : Since net electric field inside conductor is zero, The electric field due to conductor at each point inside the conductor is equal and opposite to impressed uniform electric field. Hence true.

S₃ : The electric field on both sides is same in magnitude but opposite in Direction. Hence false

S₄ : As we move from centre till surface the field increases and thereafter as we move away from surface the field decreases. Hence False.

CHEMISTRY

41.[B] $N_2 + 3H_2 \longrightarrow 2NH_3$
1 4 0

$NH_3 + H_2O \longrightarrow NH_4OH$

$NH_4OH + HCl \longrightarrow NH_4Cl + H_2O$

1 mole 1 mole

So NH_3 formed is 1 mole

$N_2 + 3H_2 \longrightarrow 2NH_3$

$\left(1-\frac{1}{2}\right)\left(4-\frac{3}{2}\right)$ (1)

$\frac{1}{2}, \quad \frac{5}{2}, \quad 1$

$$X_{H_2} = \frac{\frac{5}{2}}{\frac{1}{2}+\frac{5}{2}} = \frac{\frac{5}{2}}{3} = \frac{5}{6}$$

42.[C] $P = 3s^2\,3p^3$

3s 3p

1↓ 1 1 1 G.S.

3s 3p 3d

1 1 1 1 ☐ ☐ ☐ ☐ ☐

In excited state spin quantum no. of last e^- will be (–1/2), To obey Pauli's exclusion principle

43.[B] Meq. of oxalate = Meq. of $KMnO_4$

$$\frac{w}{88/2} \times 1000 = 90 \times \frac{1}{20}$$

$\therefore \quad w_{oxalate} = 0.198$ g

$$\% \text{ oxalate} = \frac{0.198}{0.3} \times 100 = 66\ \%$$

44.[D] $$\frac{P^\circ - P_s}{P_s} = \frac{n}{N} = \frac{n \times M}{W} = \frac{n \times M \times 1000}{W \times 1000}$$

$$= \frac{\text{molality} \times M}{1000}$$

$$\text{Thus} = \frac{100-95}{95} = \frac{m \times 18}{1000}$$

$\therefore \quad m = 2.92$

45.[C] $Be^{1s^1} < C^{2p^1} < B^{2s^2} < N^{2p^2} < F^{2p^4} < O^{2p^3} < Ne^{2p^5} < Li^{1s^2}$

46.[B] $N_2O_4 \rightleftharpoons 2NO_2$
0.28 1.1

$$K_p = \frac{P_{NO_2}^2}{P_{N_2O_4}} = \frac{(1.1)^2}{0.28} = 4.32$$

when vol. is doubled press. become half & reaction proceeds in forward direction because $Q_p \propto K_p$

$N_2O_4 \rightleftharpoons 2NO_2$

$\frac{0.28}{2} - P \quad \frac{1.1}{2} + 2P$

$$K_p = \frac{(0.55+2P)^2}{(0.14-P)} = 4.32 \Rightarrow P = 0.045$$

P_{NO_2} at new equilibrium $= 0.55 + 2 \times 0.045$

47.[C] $\alpha = \frac{D-d}{(n-1)d}$

For given reaction $n = 2$ & $\alpha = 0$ at point A

So $\frac{D}{d} = 1$

48.[C] $k = \frac{2.303}{t}\log\left(\frac{P_i}{P_t}\right)$; $(CH_3)_2N_2 \longrightarrow C_2H_6 + N_2$

$t = 0 \quad 200; \quad t \quad 200-x \quad x \quad x$

as per given $200 + x = 350 \quad x = 150$

$$\therefore k = \frac{2.303}{t}\log\left(\frac{200}{200-150}\right)$$

$k = 5.77 \times 10^{-4}$ sec^{-1}

49.[C]

BOH(weak base) + HCl(strong Acid) → BCl + H_2O

Milli-moles (t=0) → 0.2 × 500 = 100 | 0.1 × 500 = 50 | 0 | 0

End → 50 | 0 | 50 | 50

Basic Buffer

$$pOH = pK_b + \log\frac{[\text{salt}]}{[\text{base}]}$$

$$14 - 9 = pK_b + \log\frac{(50/1000\text{ ml})}{[50/1000\text{ ml}]}$$

$pK_b = 5$

Now pH of BCl solution

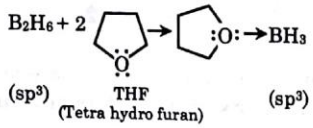
$$= 7 - \frac{1}{2}pK_b - \frac{1}{2}\log C$$

$$= 7 - \frac{1}{2} \times 5 - \frac{1}{2} \times \log(0.1)$$

$= 7 - 2.5 + 0.5 = 5$

50.[C] $A\ell(OH)_3 + NaOH \rightarrow Na[A\ell(OH)_4]$

(sp^2) (sp^3)



(sp^3) (sp^3)

$SiF_4 + 2HF \longrightarrow H_2SiF_6$

sp^3 sp^3d^2

$2PCl_5 \xrightarrow{\text{Solidification}} \overset{\oplus}{PCl_4} + \overset{\ominus}{PCl_6}$

(sp^3d) (sp^3) (sp^3d^2)

51.[A] Bond angle of NH_3 is greater than NF_3 due to more electronegativity of F, the bond pair is more towards fluorine. thus b.p.–b.p repulsions are less in NF_3. However, in PF_3, the molecule is expected to acquire partial double bond character due to resonance and this results in increase of the b.p.–b.p. repulsions to give a higher bond angle. The correct decreasing bond angle order is -

NH_3 > NF_3 > PF_3 > PH_3

(107°) (102°) (97°) (94°)

52.[D] $(H_3C)_2C=CH-CH_2-CHO \xrightarrow{[O]} (H_3C)_2C=O + OHC-CH_2-CHO \xrightarrow{[O]} H_2C(COOH)_2$

Vigorous oxidation means oxidation by strong oxidising agent like $KMnO_4$

53.[B] $CH_2-CH=CH_2 \xrightarrow{HBr} \overset{\oplus}{C}H_2-CH-$ (P)

1-2 Hydride shift

$\overset{\oplus}{C}H-CH_2-CH_3 \xleftarrow{Br^{\ominus}} CH(B)-CH_2-CH_3$ (P)

54.[A] $H_3C-CH_2-CH_2-Br$ (S) + $\overset{\ominus}{C}\equiv-\ \overset{\oplus}{Na}$ (Q)

$H-\equiv-H \xrightarrow[-NH_3]{NaNH_2} H-\equiv-\overset{\ominus}{C}$ (P) (Q)

$OH \xrightarrow{HBr} Br$ (S)

55.[A] $\Delta H_{solution} = \Delta H_{1\ attice} + \Delta H_{Hydration}$

$\Delta H_{hydration} = 4 - 756 = -752$ kJ (a KJ))

$\Delta H_{Na^+hydration} = \frac{6a}{11} = \frac{6x-752}{11} = -410.18$ kJ

56.[D] $\log\frac{x}{m} = \log k + \frac{1}{n}\log p$

$y = c + mx$

$\frac{x}{m} = 2(0.3)^1 = 0.6$

This is according to Langmuir adsorption isotherm

x = Amount of adsorbate

m = Amount of adsorbent

k = constant

p = pressure

57.[B] $\frac{r_1}{r_2} = \frac{P_1}{P_2}\sqrt{\frac{M_2}{M_1}}$

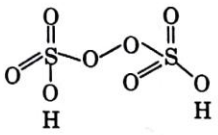
$\frac{\left(\frac{n_1}{t_1}\right)}{\left(\frac{n_2}{t_2}\right)} = \frac{P_1}{P_2}\sqrt{\frac{M_2}{M_1}} \quad \left(r = \frac{n}{t}\right)$

$\frac{\frac{1}{38}}{\left(\frac{1}{57}\right)} = \frac{0.8}{1.6}\sqrt{\frac{M_2}{28}} \Rightarrow M_2 = 252$ gm

so formula of compound is XeF_6

$\because (131 + 6 \times 19 = 245)$

58.[B] High hydration energy makes Li the strongest R.A.

59.[D] 

60.[A] Only (A)
because for positive idoform test either $-CH(OH)-CH_3$ or $-C(=O)-CH_3$ group must be present

$$Ph-CH(OH)-CH_3 \xrightarrow{IO^{\ominus}} Ph-C(=O)-CH_3 \xrightarrow{IO^{\ominus}} Ph-COO^{\ominus} + CHI_3$$

BIOLOGY

61.[B] t-RNA

62.[C] GA_3

63.[C] Diplotene

64.[C] Frame shift mutation

65.[B] 2 – 10 %

66.[B] Cladode

67.[B] Stable

68.[C] Glomus

69.[C] Lactose

70.[A] Mo

71.[C] Herbivorous diet contains more carbohydrates particularly cellulose which takes more tiem to digest

72.[C] Pseudo stratified epithelium

73.[A] SA node

74.[A] increase

75.[A] Due to ageing or some infection eye lens becomes opaque

76.[D] Glucose

77.[A] Ileum, ischium and pubis

78.[D] Spermatid to sperm

79.[A] $P^2 + 2pq + q^2 = 1$

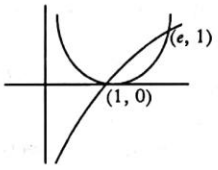
80.[A] A particular pollutant

PART-II [Two Marks Questions]

MATHEMATICS

81.[A] Required Area $= \int_1^e \left(\ell nx - (\ell nx)^2\right) dx$

Put $\ell n\, x = t \quad dx = e^t\, dt$



$$= \int_0^1 (t - t^2)e^t\, dt = e^t\left[(t-t^2) - (1-2t) + (-2)\right]_0^1$$

$$= 3 - e$$

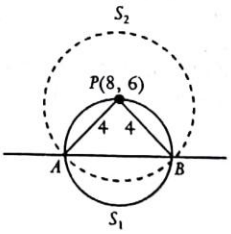
82.[C] $S_1 : x^2 + y^2 = 100$

Equation of S_2 centred at (8, 6) is

$(x-8)^2 + (y-6)^2 = 16$

$x^2 + y^2 - 16x - 12y + 84 = 0$

$\therefore$ required line AB, (i.e. common chord)



$S_1 - S_2 = 0$

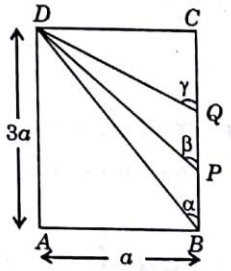
$\Rightarrow x^2 + y^2 - 16x - 12y + 84 - x^2 - y^2 + 100 = 0$

$\Rightarrow -16x - 12y + 184 = 0$

$\Rightarrow 4x + 3y - 46 = 0$

83.[B] $\int \frac{x}{\sqrt{(1+x^2)\left(1+\sqrt{1+x^2}\right)}}$; put $1+\sqrt{1+x^2} = t^2$]

84.[A] $\alpha = \tan^{-1}\frac{1}{3}$, $\beta = \tan^{-1}\left(\frac{1}{2}\right)$



$\Rightarrow \frac{CP}{CD} = \frac{1}{2} \quad \Rightarrow \quad CP = 2a$

$\gamma = \alpha + \beta = \tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{2} = \frac{\pi}{4}$

$\Rightarrow \frac{CQ}{DC} = \tan\frac{\pi}{4} = 1 \Rightarrow CQ = a$

$\Rightarrow PQ = a = AB$

P & Q are points of trisection of BC

$DQ = \sqrt{DC^2 + CQ^2} = \sqrt{AB^2 + BP^2} = AP$

85.[D] $2ABC$ is not defined

$\therefore$ there is no solution

86.[A] $f(x) = x^x$

$f'(x) = x^x(1 + \ln x) = 0 \Rightarrow x = \frac{1}{e}$

$\therefore \quad a = \frac{1}{e}$ & $b = e^{-\frac{1}{e}}$

87.[D] Consider 4 alike + 2 others alike, $4A + 2$ different

$3A + 3\,OA$ and $3A + 2\,OA + 1$ different

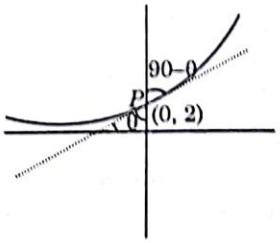
$\Rightarrow$ 15 + 30 + 20 + 120

88.[B] $\frac{2s(2s-2a)(2s-2b)(2s-2c)}{4b^2c^2}$

$= \frac{16(s)(s-a)(s-b)(s-c)}{4b^2c^2} = \frac{4\Delta^2}{b^2c^2}$

$= \frac{4\times\left[\frac{1}{2}bc.\sin A\right]^2}{b^2c^2} = \sin^2 A$

89.[B] $y = 2e^{2x}$ ...(i)



$\therefore \frac{dy}{dx} = 2 \cdot e^{2x} \cdot 2 = 4 \cdot e^{2x}$

$\therefore \left(\frac{dy}{dx}\right)$ at $P = 4$

$\therefore \tan\theta = 4 \Rightarrow \theta = \tan^{-1} 4$

$\therefore$ required angle $= 90 - \theta = \frac{\pi}{2} - \tan^{-1}4$

$= \cot^{-1}4$

90.[B] Note that

$\cos 158° = \cos(180° - 22°) = -\cos 22°$

& $\cos 98° = \cos(90° + 8°) = -\sin 8°$

Also $\cos 157° = \cos(180° - 23°)$

$= -\cos 23°$

& $\cos 97° = \cos(90° + 7°) = -\sin 7°$

$\therefore$ Given expression

$= \frac{\sin 22°\cos 8° + \cos 22°\sin 8°}{\sin 23°\cos 7° + \cos 23°\sin 7°}$

$= \frac{\sin(22°+8°)}{\sin(23°+7°)} = 1$

$\therefore$ Ans. is B

PHYSICS

91.[A] From work-energy theorem ;

Work done by the all the forces = change in kinetic energy

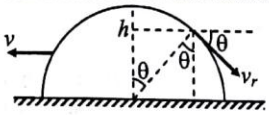
i.e., $F.x - \mu m_1 g x - \frac{1}{2}kx^2 = 0$

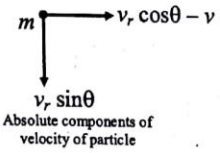
But $kx = \mu m_2 g$ for just shifting m_2.

$\therefore F.x - \mu m_1 g x - \frac{1}{2}\mu m_2 g\, x = 0$

or $F = \mu\left(m_1 + \frac{m_2}{2}\right)g = 0.4\left(1 + \frac{2}{2}\right)(10) = 8N$

92.[A] Let v_r be the velocity of particle relative to hemisphere and v the linear velocity of hemisphere at this moment. Then from conservation of linear momentum, we have





$4mv = m(v_r \cos\theta - v)$

or $5v = v_r \cos\theta$

or $v_r = \dfrac{5v}{\cos\theta}$

$\therefore \omega = \dfrac{v_r}{R} = \dfrac{5v}{R\cos\theta}$

93.[B] Distance d is constant, i.e.,

$v \cos 30° = u \cos 60°$

or $\dfrac{v\sqrt{3}}{2} = \dfrac{10}{2}$ or $v = \dfrac{10}{\sqrt{3}}$ m/s

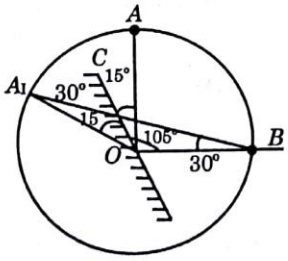
Magnitude of angular velocity of B with respect to A is :

$$\omega = \frac{u\sin 60° - v\sin 30°}{d}$$

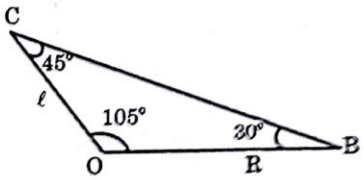
$$= \frac{(10)\frac{\sqrt{3}}{2} - \frac{10}{\sqrt{3}}\cdot\frac{1}{2}}{2} = \frac{5\sqrt{3} - \frac{5}{\sqrt{3}}}{2} = \frac{5}{\sqrt{3}} \text{ rad/s}$$

94.[B] AD and BC is constant volume process so P v/s V graph is a point as V cannot change in the graph.

95.[A]



A_1 is the image of A which is seen by b



$\angle OCB = \theta$ sum of angle of $D = 180°$

$\therefore \theta + 105 + 30 = 180$ or $\theta = 45°$

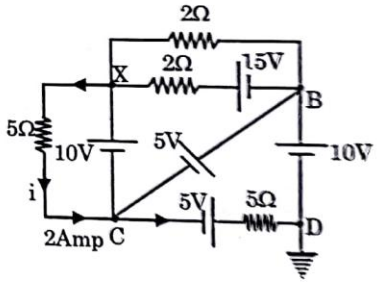
$$\frac{R}{\sin 45°} = \frac{\ell}{\sin 30°};$$

$$\frac{R}{\ell} = \frac{\sin 45°}{\sin 30°} = \sqrt{2}$$

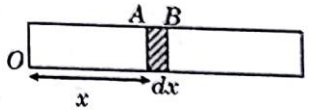
96.[B] At point D potential is 0. as it is grounded we will write potential drop along the path $XCBD$

$V_X - V_D = 10 - 5 + 10$ (with sign convention)

$V_X - 0 = 15$ or $V_X = 15$ volt



97.[B]



Consider an element AB of thickness dx at distance x

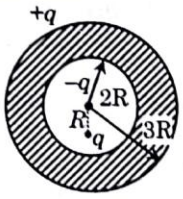
mass of element AB is $dm = \dfrac{k}{L}(mdx)$

formula for center of mass coordinate

$$= x_{com} = \frac{\int (dm)x}{\int (dm)x} = \frac{\frac{k}{L}\int_0^L x^2 dx}{\frac{k}{L}\int_0^L x\,dx} = \frac{2L}{3}$$

8.[C] Due to induction $-q$ charge will come at the inner surface of shell and $+q$ will come on outer surface of shell

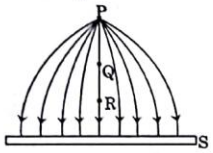
Now $V_{at0} = V_{due\ to\ q} + V_{due\ to\ -q\ on\ inner\ surface} + V_{due\ to\ +q\ on\ outer\ surface}$



$$\text{at } 0 = \frac{kq}{R} + \frac{k(-q)}{2R} + \frac{kq}{3R} = \left(k\frac{6q - 3q + 2q}{6R}\right)$$

$$= \frac{5q}{24\pi\epsilon_0 R} \quad \left(k = \frac{1}{4\pi\epsilon_0}\right)$$

99.[A] As we are moving away from P towards sheet S spacing between electric lines of force is increasing.

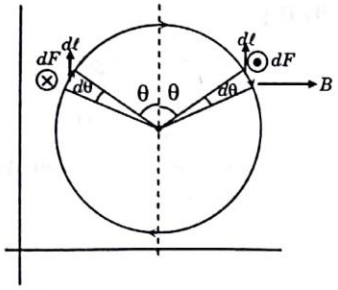


$\therefore E_R < E_Q$

In the direction of electric field potential decreases.

$\therefore V_R < V_Q$

100.[D]



$dF = i(\vec{d\ell} \times \vec{B})$

Considering $\vec{d\ell}$ at angle θ symmetrically as shown. dF on either side have same magnitude but opposite direction

$\therefore$ Both dF get cancel out net force on the loop is zero

CHEMISTRY

101.[B] Only reversible adiabatic are isoentropic. Endothermic reaction may be spontaneous if ΔS is positive.

102.[C] Let x gm of Zn deposit on 9 gm of Hg

$$\% \text{ of Zn in Amalgam} = \frac{m_{Zn} \times 100}{m_{Zn} \times m_{Hg}}$$

$$= \frac{x}{9+x} = 100 = 25$$

$\therefore x = 3$gm

$$\text{Eq. of Zn} = \frac{3 \times 2}{65.4}$$

$$\frac{n_{Zn}}{1} = \frac{n_{e^-}}{2} = \frac{Q}{2f} = \frac{it}{2f}$$

$$\text{Current } i = \frac{6}{65.4} \times \frac{96500}{1000} = 8.85 \text{ amp.}$$

103.[D] $Na_2\overset{2+}{S_2}O_3 + K\overset{+5}{B}rO_3 \rightarrow Br^- + Na_2\overset{+2.5}{S_4}O_6$

v.f = 1 v.f = 6

by m.e. of $Na_2S_2O_3$ = m.e. of $KBrO_3$

molarity of $Na_2S_2O_3 = 0.1$ M

104.[D] $d^8 \rightarrow Ni^{2+}$. $d^7 \rightarrow Ni^{3+}$

Total charge of nickel.

$(0.96 \times 2) + (0.04 \times 3) = 2.04$.

$$\text{No. of } O^{2-} \text{ ion} = \frac{2.04}{2} = 1.02.$$

Formula of solid = $NiO_{1.02} = Ni_{0.98}O$.

105.[B] $3\ N_2O + 4\ Na + NH_3$

$$\xrightarrow{NH_3(\ell)} NaN_3 + 3\ NaOH + 2\ N_2$$

$$\underbrace{2NH_3 + NaOCl}_{\text{dilute solutions}} \xrightarrow{glue} N_2H_4 + NaCl + H_2O$$

$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + Cr_2O_3\downarrow$(green)

$CaCN_2 + 3H_2O \longrightarrow CaCO_3\downarrow + 2\ NH_3$

$Cu^{2+} + 4NH_3 \longrightarrow [Cu(NH_3)_4]^{2+}$ (deep blue)

106.[A] $E_2 - E_1 = \Delta E$

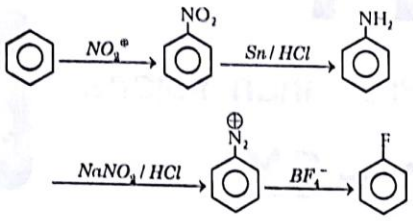
$$40.8 = 13.6\ Z^2\left(\frac{1}{1} - \frac{1}{4}\right) = 13.6 \times \frac{3}{4}Z^2$$

$Z^2 = 4 \Rightarrow Z = 2$

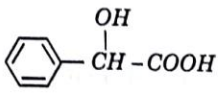
$IE = 13.6\ Z^2 = 13.6 \times 2^2 = 54.4$ ev

$KE_1 = 13.6\ Z^2 = 13.6 \times 2^2 = 54.4$ ev

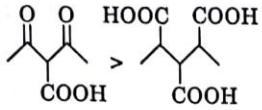
107.[A]



108.[C]

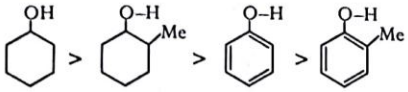


109.[A]



(rate of decarboxylation)

110.[B] Rate of esterification is faster with alcohols than phenols. The less crowded alcohol have faster rate of esterification. The observed rate of esterification is



BIOLOGY

111.[D] 18 ATP and 12 NADPH

112.[D] Pollen sacs

113.[A] 3 : 1

114.[C] Expressed in males

115.[B] Nucleotide sequence

116.[A] One X-chromosome (44 with XO)

117.[A] Sugar

118.[A] Separation of cytosol and nucleus

119.[C] β-galactosidase

120.[D] Primer and DNA polymerase

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-7

Stream – SX

Hints & Solutions

Answer key

1.(B)	2.(C)	3.(B)	4.(A)	5.(C)	6.(C)	7.(A)	8.(C)	9.(A)	10.(C)	11.(D)	12.(C)	13.(B)	14.(A)
15.(B)	16.(B)	17.(C)	18.(A)	19.(B)	20.(C)	21.(C)	22.(D)	23.(B)	24.(A)	25.(C)	26.(A)	27.(C)	28.(C)
29.(C)	30.(B)	31.(D)	32.(D)	33.(C)	34.(A)	35.(C)	36.(A)	37.(D)	38.(B)	39.(D)	40.(B)	41.(C)	42.(B)
43.(C)	44.(B)	45.(C)	46.(B)	47.(C)	48.(A)	49.(D)	50.(D)	51.(C)	52.(D)	53.(D)	54.(C)	55.(B)	56.(B)
57.(C)	58.(A)	59.(A)	60.(D)	61.(C)	62.(B)	63.(A)	64.(A)	65.(C)	66.(C)	67.(D)	68.(D)	69.(B)	70.(C)
71.(B)	72.(C)	73.(C)	74.(A)	75.(B)	76.(C)	77.(A)	78.(B)	79.(C)	80.(B)	81.(D)	82.(B)	83.(A)	84.(D)
85.(A)	86.(B)	87.(D)	88.(A)	89.(A)	90.(B)	91.(A)	92.(A)	93.(A)	94.(A)	95.(D)	96.(C)	97.(A)	98.(B)
99.(D)	100.(B)	101.(C)	102.(A)	103.(A)	104.(B)	105.(D)	106.(A)	107.(A)	108.(A)	109.(D)	110.(B)	111.(C)	112.(A)
113.(B)	114.(A)	115.(B)	116.(B)	117.(C)	118.(B)	119.(C)	120.(B)						

PART-I [One Mark Questions]

MATHEMATICS

1.[B] $\lim_{n\to\infty}\left[\frac{1}{2}+\frac{1}{2^2}+\ldots+\frac{1}{2^n}\right]$

$$\lim_{n\to\infty}\left[\frac{1/2(1-1/2^n)}{1-\frac{1}{2}}\right]$$

$\because$ $n\to\infty$ $1-1/2^n<1$

$\therefore$ $\lim_{n\to\infty}\left[1-\frac{1}{2^n}\right]=0$

2.[C] $f(x)=ax^2+bx+c$

$f(\pi)=a\pi^2+b\pi+c=0$ ...(1)

$f(-\pi)=a\pi^2-b\pi+c=0$ ...(2)

$(1)-(2)\Rightarrow b=0$

$f(\pi/2)$ $\Rightarrow \frac{a\pi^2}{4}+c=\frac{-3\pi^2}{4}$

from (1), $\frac{a\pi^2}{4}-a\pi^2=\frac{-3\pi^2}{4}$

$\Rightarrow \frac{-3a\pi^2}{4}=\frac{-3\pi^2}{4}$

$\Rightarrow a=1, c=-\pi^2$

$f(x)=x^2-\pi^2$

$\lim_{x\to-\pi}\frac{x^2-\pi^2}{\sin(\sin x)}$ (using L-H)

$=\lim_{x\to-\pi}\frac{2x-0}{\cos(\sin x)\cos x}$

$=\frac{-2\pi}{\cos(0)\cos(-\pi)}=2\pi$

3.[B] $f(x)=\begin{cases}x^2-\ell nx^2, & x\geq 0\\ -x^2-\ell nx^2, & x<0\end{cases}$

$f'(x)=\begin{cases}2x-2/x, & x>0\\ -2x-2/x, & x<0\end{cases}$

$$= \begin{cases} \dfrac{2(x-1)(x+1)}{x}, & x>0 \\ \dfrac{-2(x^2+1)}{x}, & x<0 \end{cases}$$

$$\underset{0}{+}\ \underset{1}{-}\ +$$

$\uparrow (1,\infty)$
$\downarrow (0,1)$
$\uparrow (-\infty,0)$

4.[A] $f(x) = \dfrac{10}{x^{12}+2+3x^4+\frac{3}{x^4}+\frac{1}{x^{12}}}$

$$= \frac{10}{x^{12}+3x^4+\frac{3}{x^4}+\frac{1}{x^{12}}+2} = \frac{10}{\left(x^4+\frac{1}{x^4}\right)^3+2}$$

$\because x^4+\dfrac{1}{x^4} \geq 2 \Rightarrow \left(x^4+\dfrac{1}{x^4}\right)^3+2 \geq 10$

$\therefore f(x) \leq \dfrac{10}{10} = 1$

5.[C] $\cos\pi(x+y)\cos\pi(x-y) = \dfrac{1}{2}$

$\cos\pi(x+y) = 1$

$\pi(x+y) = 2n\pi$

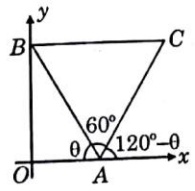
$x+y = 2n$

$x-y = \dfrac{1}{3}$

Hence, $x = n+\dfrac{1}{6}$

$y = n-\dfrac{1}{6}$

6.[C]



$A(2\cos\theta, 0)$ $B(0, 2\sin\theta)$ $C(h, k)$

from diagram

$h = 2\cos\theta + 2\cos(120°-\theta) = \cos\theta + \sqrt{3}\sin\theta$

$k = 2\sin(120°-\theta) = \sin\theta + \sqrt{3}\cos\theta$

$h^3 + k^2 = 4 + 4\sqrt{3}\sin\theta\cos\theta;\ hk$

$= \sqrt{3} + 4\sin\theta\cos\theta$

now eleminating θ

$h^2 + k^2 = \sqrt{3}\,hk + 1$

7.[A] $f(x) = g(x) + h(x)$

even odd

$\Rightarrow g(x) = \dfrac{a^x + a^{-x}}{2}$

$g(x+y) + g(x-y)$

$$= \frac{a^{x+y}+a^{-y-x}}{2} + \frac{a^{x-y}+a^{y-x}}{2}$$

$$= \frac{1}{2}[a^x.a^y + a^x.a^{-y} + a^y.a^{-x} + a^{-x}a^{-y}]$$

$$= \frac{1}{2}[a^x(a^y+a^{-y}) + a^{-x}(a^y+a^{-y})]$$

$$= \frac{1}{2}(a^y+a^{-y})(a^x+a^{-x})$$

$= 2\,g(x)\,.\,g(y)$

8.[C] $f(x+\pi) = (-1)^{\left[\frac{2x}{\pi}+2\right]} = (-1)^{\frac{2x}{\pi}} = f(x)$

period $= \pi$

$g(x+\pi) = g(x) \rightarrow$ period $= \pi$

$\phi(x) = f(x)\,g(x) = (-1)^{\left[\frac{2x}{\pi}\right]}.(|\sin x|-|\cos x|)$

$\phi\left(\dfrac{\pi}{2}+x\right) = (-1)^{\left[\frac{2x}{\pi}\right]}.(-1)[|\cos x|-|\sin x|]$

$= f(x)\,.\,g(x) \rightarrow$ period $= \dfrac{\pi}{2}$

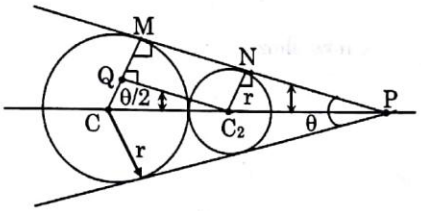
9.[A] In ΔC_1C_2Q

$\sin\left(\dfrac{\theta}{2}\right) = \dfrac{C_1Q}{C_1C_2} = \dfrac{3}{5}$

$\cos\left(\dfrac{\theta}{2}\right) = \dfrac{C_1Q}{C_1C_2} = \dfrac{4}{5}$

$\therefore \sin\theta = 2\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\theta}{2}\right)$

$= 2\left(\frac{3}{5}\right)\left(\frac{4}{5}\right) = \frac{24}{25}$



10.[C] $|\vec{a}\times\vec{b}| = 2$

$[\vec{a}\ \vec{b}\ \ \vec{a}\times\vec{b}]$

$[\vec{a}\times\vec{b}\ \ \vec{a}\ \vec{b}] = (\vec{a}\times\vec{b}).(\vec{a}\times\vec{b}) = |\vec{a}\times\vec{b}|^2 = 4$

11.[D]

$$\text{mean} = \frac{\Sigma x_i w_i}{\Sigma w_i} = \frac{0C_0 + 1C_1 + ...nC_n}{C_0 + C_1 + ... + C_n} = \frac{n.2^{n-1}}{2^n}$$

12.[C] Let $b = ar$, $c = ar^2$

$$x = \frac{a(1+r)}{2}$$

$$y = \frac{ar(1+r)}{2}$$

$$\left(\frac{a}{x}+\frac{c}{y}\right)\left(\frac{b}{x}+\frac{b}{y}\right) = \left\{\frac{a\times 2}{a(1+r)} + \frac{ar^2\times 2}{ar(1+r)}\right\}$$

$$\left\{\frac{ar\times 2}{a(1+r)} + \frac{ar\times 2}{ar(1+r)}\right\}$$

$$= \left\{\frac{2}{1+r} + \frac{2r}{1+r}\right\}\left\{\frac{2r}{1+r} + \frac{2}{1+r}\right\} = 4$$

13.[B] Here, $\sqrt{a}x + \sqrt{b}y = 1$

Squaring both sides, $ax + by + 2\sqrt{abxy} = 1$

or $2\sqrt{abxy} = (1 - ax - by)$ again squaring

$4abxy = 1 + a^2x^2 + b^2y^2 - 2ax - 2by + 2abxy$

$a^2x^2 + b^2y^2 - 2abxy - 2ax - 2by + 1 = 0$

which is clearly as parabola.

$(H^2 - AB = 0\ ;\ \Delta \neq 0)$

14.[A] $|A| = 2^4$, $|\text{adj}\,.\,(\text{adj}\,A)| = (2^4)^9 = 2^{36}$

$$\Rightarrow \left\{\frac{\det(adj.(adj\,A))}{7}\right\} = \left\{\frac{2^{36}}{7}\right\}$$

$$= \left\{\frac{8^{12}}{7}\right\} = \left\{\frac{(7+1)^{12}}{7}\right\} = \frac{1}{7}$$

15.[B] Given $f(x + c) = 1 + [(1 - f(x))^5]^{1/5}$

$\Rightarrow f(x + c) = 1 + [1 - f(x)]$

$\Rightarrow f(x + 2c) = 1 + [1 - f(x + c)]$

$= 1 + [1 - 1 - 1 + f(x)]$

$= 1 + f(x) - 1 = f(x + 2c) = f(x)$

Hence $f(x)$ is a periodic function of period $2c$.

16.[B] *A.M.* > *G.M.*

$$\frac{a^{101} + c^{101}}{2} > (\sqrt{ac})^{101} > b^{101}$$

$2b^{101} - a^{101} - c^{101} < 0$

17.[C] The polynomial is an every where differentiable function. Therefore, the points of extremum can only be the roots of the derivative. Furthermore, the derivative of a polynomial is a polynomial. The polynomial of the least degree with roots $x = 1$ and $x = 3$ has the form $a(x - 1)(x - 3)$.

Hence, $P'(x) = a(x - 1)(x - 3)$.

Since at $x = 1$, we must have $P(1) = 6$, we have

$$P(x) = \int_1^x P'(x)\,dx + 6 = a\int_1^x (x^2 - 4x + 3)dx + 6$$

$$= a\left(\frac{x^3}{3} - 2x^2 + 3x - \frac{4}{3}\right) + 6$$

Also $P(3) = 2$ so $a = 3$.

Hence $P(x) = x^3 - 6x^2 + 9x + 2$.

Thus, $\int_0^1 P(x)\,dx = \frac{1}{4} - 2 + \frac{9}{2} + 2 = \frac{19}{4}$

18.[A] $S\equiv(\sin^2\theta)x^2+2hxy+(\cos^2\theta)y^2+32x+16y+19=0$ ..... (1)

$S'\equiv(\cos^2\theta)x^2+2h'xy+(\sin^2\theta)y^2+16x+32y+19=0$ ..... (2)

$\because$ Curve passing through point of intersection of S & S' is $S+\lambda S'=0$

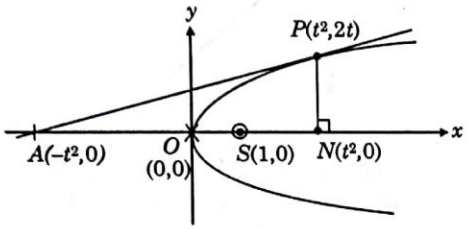
$\Rightarrow x^2(\sin^2\theta+\lambda\cos^2\theta)+y^2(\cos^2\theta+\lambda\sin^2\theta)+2xy(h+\lambda h')+x(32+16\lambda)+y(16+32\lambda)+19(1+\lambda)=0$

For this equation to be a circle, then

$\sin^2\theta+\lambda\cos^2\theta=\cos^2\theta+\lambda\sin^2\theta\Rightarrow\lambda=1$

and $h+\lambda h'=0\Rightarrow h+h'=0$

19.[B] $y^2=4x$ ..... (1)



Equation of tangent at point P is $\Rightarrow ty=x+t^2$

where, slope of tangent is

$\tan\theta=\frac{1}{t}$

Now, required area is

$\Delta=\frac{1}{2}(AN)(PN)$

$=\frac{1}{2}(2t^2)(2t)$

$\Delta=2t^3=2(t^2)^{3/2}$ ..... (2)

Now, $t^2\in[1,4]$

then $\Delta_{maximum}=2(4)^{3/2}=16$, when $t^2=4$

20.[C] $f'(x)=\lim\limits_{h\to0}\frac{f(x+h)-f(x)}{h}$

$=\lim\limits_{h\to0}\frac{f(x+2(h/2))-f(x+2.0)}{h}$

$f'(x)=\lim\limits_{h\to0}\frac{f(x)+f(h)+4x(h/2)-f(x)-f(0)}{h}$

$=\lim\limits_{h\to0}\frac{f(h)-f(0)}{h}+2x$

(from given fx, put $x=y=0$, $f(0)=0$)

$f'(x)=f'(0)+2x\Rightarrow f'(x)=2x$

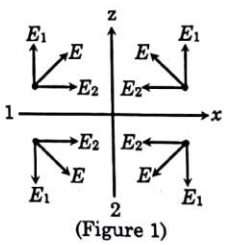
$\Rightarrow f(x)=x^2+c$, put $x=0\Rightarrow c=0$

$f(x)=x^2$, $I_1=1/3$, $I_2=1/3$ and $I_3=21/8$

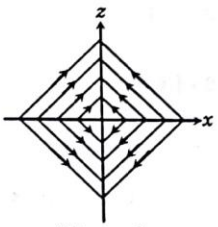
$\therefore I_1=I_2<I_3$

PHYSICS

21.[C] The electric field intensity due to each uniformly charged infinite plane is uniform. The electric field intensity at points A, B, C and D due to plane 1, plane 2 and both planes are given by E_1, E_2 and E as shown in figure 1. Hence the electric lines of forces are as given in figure 2.



(Figure 1)



(Figure 2)

Aliter :

Electric lines of force originate from positively charged plane and terminate at negatively charged plane. Hence the correct representation of *ELOF* is as shown figure 2.

22.[D] Apply K.V.L.

$i.5+2+i.3+i.6+i.2-4=10$

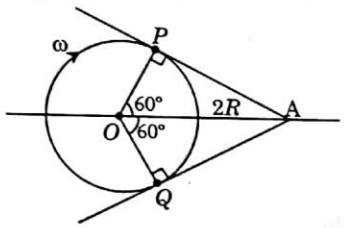
$16i=12$

$i=\frac{3}{4}A$

Potential difference between B and C is

$2+3\times\frac{3}{4}=4.25$ V

23.[B] Point A shell record zero magnetic field (due to α-particle) when the α-particle is at position P and Q as shown in figure. The time taken by α-particle to go from P to Q is



$$t = \frac{1}{3}\frac{2\pi}{\omega};\quad \omega = \frac{2\pi}{3t}$$

24.[A] $e = \frac{BdA}{dt} = \frac{Bd}{dt}(\pi r^2) = B2\pi r\frac{dr}{dt}$

25.[C] R_1

26.[A] ℓ

27.[C] There can be three minima from central point to ∞ corresponding to $\frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}$ path differences.

$\therefore$ Total number of minima $= 2n_{max} = 6$

28.[C] The circuit will have inductive nature if

$$\omega > \frac{1}{\sqrt{LC}}\left(\omega L > \frac{1}{\sqrt{LC}}\right)$$

Hence A is false. Also if circuit has inductive nature the current will lag behind voltage. Hence D is also false

If $\omega = \frac{1}{\sqrt{LC}}\left(\omega L = \frac{1}{\omega C}\right)$ the circuit will have resistance nature. Hence B is false

Power factor

$$\cos\phi = \frac{R}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}} = 1$$

If $\omega L = \frac{1}{\omega C}$.

Hence C is true

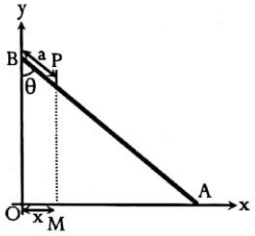
29.[C] Energy released

$= (80 \times 7 + 120 \times 8 - 200 \times 6.5)$

$= 220$ MeV

30.[B] $\frac{d\theta}{dt} = 2 \qquad \therefore \theta = 2t$

Let $BP = a \ \therefore x = OM = a\sin\theta = a\sin(2t)$



Hence M executes SHM within the given time period and its acceleration is opposite to 'x' that means towards left

31.[D] For polytropic process

$$C = C_V - \frac{R}{(n-1)}$$

$$\frac{R}{10} = -\frac{R}{(n-1)} \quad \therefore n = -9$$

32.[D] None of these

33.[C] Acceleration of mass at distance x

$a = g(\sin\theta - \mu_0 \times \cos\theta)$

speed is maximum, when $a = 0$

$g(\sin\theta - \mu_0 \times \cos\theta) = 0$

$$x = \frac{\tan\theta}{\mu_0}$$

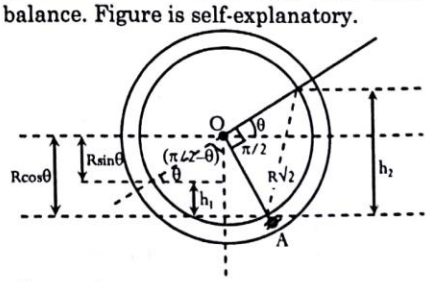
34.[A] After a time t, velocity of observer $V_0 = at$

$$\therefore \quad f_0 = \left(\frac{V + V_0}{V}\right)f_s = \left(\frac{V + at}{V}\right)f_s,$$

Which is straight line graph of positive slope

35.[C] R/3

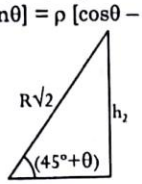
36.[A] Pressure at 'A' from both side must balance. Figure is self-explanatory.



$\sigma h_2 g = \rho h_1 g$

$\sigma \sin(45° + \theta) = \rho R\,[\cos\theta - \sin\theta]$

$\sigma[\cos\theta + \sin\theta] = \rho\,[\cos\theta - \sin\theta]$



$$\tan\theta = \frac{\rho - \sigma}{p + \sigma}$$

37.[D] The electron ejected with maximum speed v_{max} are stopped by electric field $E = 4$N/C after traveling a distance $d = 1$m

$$\therefore \frac{1}{2} m V_{max}^2 = eEd = 4 \text{ eV}$$

The energy of incident photon $= \dfrac{1240}{200}$

$= 6.2$ eV

From equation of photo electric effect

$$\frac{1}{2} m v_{max}^2 = h\nu - \phi_0$$

$$\therefore \quad \phi_0 = 6.2 - 4 = 2.2 \text{ eV}$$

38.[B] $\dfrac{KQ_0}{mv^2 + KqQ_0}$

39.[D] $i(t) = -\dfrac{1}{R}\dfrac{d\phi}{dt} = 2bt - 3at^2$

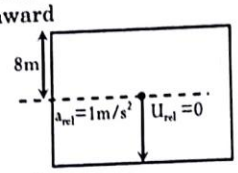
i is maximum when $\dfrac{di}{dt} = 0$

or $t = \dfrac{2b}{6a}$

Using values, at $t = 1$ s,

i maximum its value $= 12 - 6 = 6$A

40.[B] Relative to left initial velocity and acceleration of coin are 0 m/s and 1 m/s² downward



$$\therefore \quad 2 = \frac{1}{2}(1)t^2 \text{ or } t = 2 \text{ second}$$

CHEMISTRY

41.[C] $eQ.$ of $Na_2C_2O_4$ + $eQ.$ of $H_2C_2O_4$ = $eQ.$ of $KMnO_4$

$V \times 0.1 \times 5$

$2 + 2 = 0.5\ V;\quad V = 8L$

$eQ.$ of $H_2C_2O_4$ = $eQ.$ of $NaOH$

$\Rightarrow 1 \times 2 = 0.2 \times V_2;\ V_2 = 10\ L$

Hence, $V_1 : V_2 = 8 : 10 = 4:5$

42.[B] $\because \quad mvr_n = \dfrac{nh}{2\pi}$ and $p = \dfrac{h}{\lambda}$

$= pr_2 = \dfrac{2 \times h}{2 \times \pi} \Rightarrow \dfrac{h}{\pi}$

or $\quad \dfrac{h}{\lambda} . r_2 = \dfrac{h}{\pi} \Rightarrow \lambda = \pi r_2,$

$\therefore \quad r_2 = 4a_0;$

$\therefore \quad \lambda = 4a_0\pi$

43.[C] $300 = \sqrt{\dfrac{3RT}{4 \times 10^{-3}}}\ ;\ RT = 120$

Total K.E. of He gas $= \dfrac{3}{2} nRT$

$= \dfrac{3}{2} \times \dfrac{8}{4} \times 120\,\text{J} = 360\,\text{J}$

44.[B] $w = -nRT \ln \dfrac{P_1}{P_2}$

$= -10 \times 8.314 \times 300 \ln \dfrac{10}{1}$

$= -57441.42$ J

$w = -$ mgh

$\therefore\ m \times 9.81 \times 100 = 57441.42$

$m = 58.55$ kg

45.[C] $M_0 = \dfrac{dRT}{P} = 57.47$

$\alpha = \dfrac{99 - 57.47}{57.47} = 0.72$

46.[B] $k = \frac{2.303}{t}\log\left(\frac{C_{A_0}}{C_A}\right)$

$2.303 \times 1 = 2.303 \log\left(\frac{C_{A_0}}{C_A}\right)$

$\frac{C_{A_0}}{C_A} = 10$

$\therefore C_A \Rightarrow \frac{1}{10} \Rightarrow 0.1$

$\therefore$ Rate after 1 min $r_1 = k.C_A$

$\Rightarrow 2.303 \times 0.1 \Rightarrow 0.2303\ \text{M min}^{-1}$

47.[C] $Cu(OH)_2(s) \rightleftharpoons \underset{S}{Cu^{2+}}(aq.) + \underset{2S}{2OH^-}(aq.)$

$K_{sp} = 4S^3$

$\therefore S = 4 \times 10^{-7}$

$[OH^-] = 2S = 8 \times 10^{-7}$

$pOH = 6.1 \quad \therefore pH = 7.90$

48.[A] $\frac{W}{M} \times n = \frac{I \times t}{96500}$; $\frac{0.838}{184} \times n$

$= \frac{40 \times 60 \times 1.0}{96500} \Rightarrow n = 6$

49.[D] $\frac{P^\circ - P}{P^\circ} = x_{\text{solute}}$ or $\frac{P^\circ - P}{P^\circ} = \frac{n}{n+N}$

$\Rightarrow \frac{0.1}{0.1+9.9} \Rightarrow 0.01;\ P = 0.99\ P^\circ$

50.[D] Effective no. of atoms in a unit cell = 4

No. of atoms = $\frac{8}{\text{8}} \times N_A$

$\therefore$ No. of unit cell = $\frac{N_A}{10} \times \frac{1}{4}$

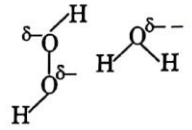
51.[C]

52.[D] Second ionization energy is amount of energy required to take out an electron from the monopositive cation.

Hence, $M(g) \rightarrow M^{2+} + 2e^-$

$M(g) \rightarrow M^+ + e^-$

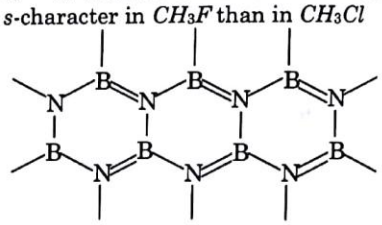
53.[D] Strength of H-bonding is higher in H_2O, than H_2O_2 because the amount of formal negative charge on oxygen atom in case of water is more than that of H_2O_2.



54.[C] (A) Acidic strength of HBr > HCl and their reducing properties are also in same order

(B) Basic strength of PH_3 > AsH_3, their bond angles are also in same order

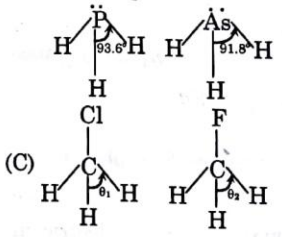
$\theta_2 > \theta_1$ because $C—H$ bond has more s-character in CH_3F than in CH_3Cl



each layer is planar as both B and N are sp^2 hybridized

(d)

(D) K_{a_1} of maleic acid is higher than K_{a_1} of fumaric acid but reverse is true for their K_{a_2}



55.[B]

BF_3	sp^2	Trigonal planar
BrF_3	sp^3d	Bent 'T' shape
$ICl_2^\ominus$	sp^3d	Linear
$BeCl_2$	sp	Linear
BCl_3	sp^2	Trigonal planar
PCl_3	sp^3	Trigonal planar
PCl_3	sp^3	Pyramidal
NCl_3	sp^3	Pyramidal

56.[B] CO bond strength is reciprocal to the extent of back donation involved in synergic bonding i.e. M $\rightleftharpoons$ CO

57.[C] $2AgCl + Na_2CO_3 \rightarrow 2NaCl + Ag_2CO_3$

$\xrightarrow{\Delta} 2Ag + \frac{1}{2}O_2 + CO_2\uparrow$

58.[A] $NH_4Cl \xrightarrow{\Delta} NH_3 + HCl$

$Y \quad Z$

$NH_3 + 2K_2[HgI_4] + 3KOH \rightarrow H_2NHgO.HgI + 7KI + H_2O$

Nessler's reagent — brown ppt. iodide of Millon's base

59.[A] $Ca(NH) + 2H_2O \rightarrow Ca(OH)_2 + NH_3(g)$

$2NH_3 + 3CaOCl_3 \rightarrow N_2(g) + 3CaCl_2 + 3H_2O$

(B) (C)

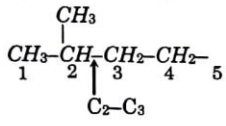
$N_2(g) + 3Mg \rightarrow Mg_3N_2$

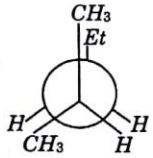
(C) (D)

$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$

(D) (B)

60.[D]





BIOLOGY

61.[C] Water

62.[B] Phosphodiester bond

63.[A] Ammonia

64.[A] Cycas

65.[C] Acetyl CoA

66.[C] Methanogens

67.[D] Protein glycosylation

68.[D] Meiocyte

69.[B] Bivalent

70.[C] in post translational modification of proteins and glycosidation of lipids

71.[B] A → R, B → Q, C → S, D → P

72.[C] Follicular phase - Secretory phase

73.[C] A-ii, B-iii, C-i, D-iv

74.[A] Defence mechanisms of body

75.[B] Lymphocyte

76.[C] A (iii), B (i), C (ii), D (iv)

77.[A] Peroxidase

78.[B] i-P; ii-M; iii-N; iv-O

79.[C] the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

80.[B] 900 c.c.

PART-II [Two Marks Questions]

MATHEMATICS

81.[D] $x + 1 = {}^nC_n + {}^nC_{n-1} + {}^{n+1}C_{n-1} + \ldots + {}^{2n-1}C_{n-1}$

$= {}^{2n}C_n$

$\therefore \quad \frac{x+1}{n+1} = \frac{{}^{2n}C_n}{n+1} = \frac{{}^{2n+1}C_{n+1}}{2n+1} \in I$

if $2n + 1$ & $n + 1$ are co-prime

Let $2n + 1 = \lambda I_1$ & $n + 1 = \lambda l_2$

$\therefore \quad \frac{2n+1}{\lambda} - \frac{2(n+1)}{\lambda} = I_1 - 2I_2$

$-\frac{1}{\lambda} = I_1 - 2I_2 \in I$

$\therefore \quad \lambda = \pm 1$

So $2n + 1$ & $n + 1$ are co-prime

$\therefore \quad \frac{x+1}{n+1}$ is always integer

82.[B] $ax^2 + bx + c = 0 \begin{matrix} x_1 \\ x_2 \end{matrix}$

$py^2 + 2y + c = 0 \begin{matrix} y_1 \\ y_2 \end{matrix}$

$x_1 + x_2 = -b/q$ and $y_1 + y_2 = -q/p$

Centre $\left[\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right] \equiv \left[-\frac{b}{2a}, \frac{-q}{2p}\right]$

[Hint : required equation is

$x^2 + y^2 + \frac{b}{a}x + \frac{q}{p}y + \frac{c}{a} + \frac{c}{p} = 0 \Rightarrow B$

83.[A] $u^2 - 2u + 2 = 0$

$\Rightarrow u = 1 \pm i$ $LHS^{\frac{[(\cot\theta-1)+(1+i)]^n - [(\cot\theta-1)+(1-i)]^n}{2i}}$

$= \frac{(\cos\theta + i\sin\theta)^n - (\cos\theta - i\sin\theta)^n}{\sin^n\theta\, 2i}$

$= \frac{2i\sin n\theta}{\sin^n\theta\, 2i} = \frac{\sin n\theta}{\sin^n\theta}$

84.[D] None of these

85.[A] Slope of the tangent $\frac{dy}{dx} = \frac{1}{(1-x)^2}\Big|_{x=2} = 1$

Equation of tangent is

$y + 1 = 1\,(x - 2)$ i.e. $y = x - 3$

Parabola $y = -a^2x^2 + 5ax - 4$

Solving the equations of tangent and the parabola

$x - 3 = -a^2x^2 + 5ax - 4$

$a^2x^2 + (1 - 5a)x + 1 = 0$

Since x is real $\therefore (1-5a)^2 - 4a^2 \geq 0$

$\Rightarrow a \leq \frac{1}{7}$ or $a \geq \frac{1}{3}$

Sum of roots $= \frac{5a-1}{a^2} = 2 \times 2$

$4a^2 - 5a + 1 = 0$ $a = 1, \frac{1}{4}$ [$a = \frac{1}{4}$ is rejected]

$\therefore S = 1$ $\therefore 12S = 12$

86.[B] [9 cases] 0 0 0 0 0 0 0 0 0 $= {}^9C_3 = 84$

or co-eff. of x^6 in

$(1 + x + x^2 + x^3 + x^4 + x^5 + x^6)^4$ Treat *W*, *B*, *G*, *R* as beggar]

87.[D] $c^2 = a^2 + b^2$

$\Rightarrow \angle C = \frac{\pi}{2}$

$\therefore \Delta = \frac{1}{2}ab\sin C = \frac{1}{2}ab$

$\Rightarrow \sqrt{s(s-a)(s-b)(s-c)} = \frac{1}{2}ab$

$\Rightarrow 4s(s-a)(s-b)(s-c) = a^2b^2$

88.[A] I.F. $= e^{\int -1dx} = e^{-x}$

$\therefore ye^{-x} = \int e^{-x}(\cos x - \sin x)dx$

$= \int e^{-x}((-1)\sin x + \cos x)dx$

$= e^{-x}\sin x + c$

$\therefore y = \sin x + c\,e^x$

Now $\lim_{x\to\infty} e^x = \infty$ but since y is bounded

$\therefore c = 0$

$\therefore y = \sin x$ is the solution

89.[A] $2px + y\sqrt{1-p^2} = 1$

i.e. $y = -\frac{2p}{\sqrt{1-p^2}}x + \frac{1}{\sqrt{1-p^2}}$ ....(i)

Let $m = -\frac{2p}{\sqrt{1-p^2}}$. Then $1 - p^2 = \frac{4}{4+m^2}$

$\therefore$ equation of the line (i) becomes

$y = mx + \frac{\sqrt{4+m^2}}{2}$

i.e. $y = mx + \sqrt{\frac{m^2}{4} + 1}$

$\therefore$ the curve is an ellipse for which

$b^2 = \frac{1}{4}$ and $a^2 = 1$

$\therefore e^2 = \frac{3}{4}$

$\therefore e = \frac{\sqrt{3}}{2}$

90.[B] $A^3 = O$

$(I + A + A^2)(I - A) = I - A^3 = I$

$\therefore I + A + A^2 = (I - A)^{-1}$

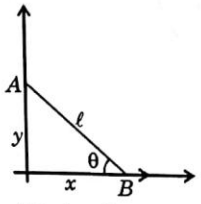
$A^3 = O$

Now $(I + A + A^2)(I - A) = I - A^3 = I$

$\therefore I + A + A^2 = (I - A)^{-1}$

PHYSICS

91.[A]



$x^2 + y^2 = \ell^2$

$\Rightarrow \frac{dy}{dt} = -\left(\frac{x}{y}\right)\frac{dx}{dt}$

$\therefore\ v_A = -\frac{4}{3}v_0$

Now, $x = \ell\cos\theta$

$\frac{dx}{dt} = -\ell\sin\theta\frac{d\theta}{dt} \Rightarrow \omega = -\frac{5}{3}\left(\frac{v_0}{\ell}\right)$

92.[A] Let the force producing impulse J is F then

$\tau_{about}\ C = I\alpha$

$F \times h = \frac{2}{5}MR^2 \times \alpha$

and $F = Ma$ (where $a = R\alpha$)

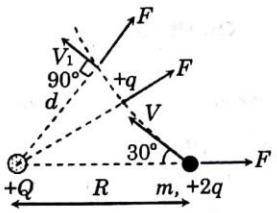
$\therefore\ Mah = \frac{2}{5}MRa \Rightarrow h = \frac{2}{5}R$

Also impulse = change in momentum

or $J = Mv$

$\therefore\ v = \frac{J}{M}$

93.[A]



Force F acting on $+2q$ passes through Q so τ of force F about $Q = 0$

$\therefore$ angular momentum about Q remain conserved

$L_i = L_f$

$mVR\sin30° = mV_1d$

$\frac{mVR}{2} = \frac{mVd}{\sqrt{3}}$

$d = \frac{\sqrt{3}R}{2}$

94.[A] For spring block system

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{m\ell}{2mg}} = 2\pi\sqrt{\frac{\ell}{2g}}$

95.[D] $\xrightarrow[K\text{ nuclei/sec}]{\text{Production}} A \xrightarrow[\lambda]{\text{Decay}} B$

Rate of change of number nuclei of $A = \frac{dN}{dt}$

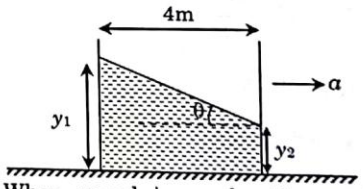
= Rate of formation of A– Rate of decay of $A = K - \lambda N$ where N is number of nuclei of A at time t

$\frac{dN}{dt} = K - \lambda N \Rightarrow \int_{N_0}^{N}\frac{dN}{K-\lambda N} = \int_0^t dt$

$N = \frac{K}{\lambda}(1 - e^{-\lambda t}) + N_0 e^{-\lambda t}$

After long time $t = \infty$ number of nucleus will become $\frac{K}{\lambda}$

96.[C]



When vessel is accelerating surface of fluid get inclined at angle θ where $\tan\theta$ is given by $\frac{a}{g}$

$\tan\theta = \frac{a}{g} = \frac{y_1 - y_2}{4}$

$y_1 - y_2 = 0.5$ ...(1)

Volume of water in container

$4\left(\frac{y_1 + y_2}{2}\right) \times 3 = 18$ ...(2)

From (1) and (2)

$y_1 + y_2 = 3$

$y_1 - y_2 = 0.5$

$y_2 = \frac{2.5}{2}$

velocity of water coming out from small orifice $V = \sqrt{2gy_2}$ (this result is from Bernoulli equation)

$v = \sqrt{2\times10\times\frac{2.5}{2}} = 5$

97.[A] Heat rejected by 100 g of water at 80° C when its temperature becomes O°C is

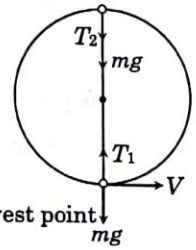
$Q = m\ s\ \Delta\theta = (100)\ (1)\ (80) = 8000$ cal

But this heat can melt $m = \frac{Q}{L}$

$= \frac{8000}{80} = 100$ g of ice only

So , temperature remains 0°C

98.[B] AT lowest point applying NLM



At lowest point mg

$T_1 - mg = \frac{mv^2}{r}$

$T_{bottom} = \frac{mv^2}{r} + mg$

At highest point

$T_2 + mg = \frac{mv^2}{r}$

$T_2 = \frac{mv^2}{r} - mg$

$T_{top} = \frac{mv^2}{r} - mg$

$\frac{T_{Top}}{T_{Bottom}} = \frac{\frac{v^2}{r} - g}{\frac{v^2}{r} + g} = \frac{39}{41}$

99.[D] for Ist magnet

twist in spring = 180 – 30 and this twist produce restoring torque magnet will finally stay in equilibrium position where both magnetic torque of horizontal component of earth magnetic field and spring torque are balanced

$C[180 - 30] = M_1 B_H \sin 30°$ ... (1)

for IInd magnet

$C[270 - 30] = M_2 B_H \sin 30°$ ... (2)

from (1) and (2)

$\frac{M_1}{M_2} = \frac{150}{240} = \frac{5}{8}$

$\frac{M_1}{M_2} = \frac{5}{8}$

100.[B] $i = \frac{E}{R}\left(1 - e^{-\frac{Rt}{L}}\right)$

where $R = 2 + 3 = 5\Omega$, $L = 10 \times 10^{-3}$ Henry

at time t_1 $i = \frac{1}{2} \times$ (steady value of current)

$i = \frac{1}{2} \times \frac{E}{R} \Rightarrow \frac{E}{2R}$

$i = \frac{E}{R}\left[1 - e^{\frac{-Rt}{L}}\right] \Rightarrow \frac{E}{2R} = \frac{E}{R}\left[1 - e^{\frac{-Rt}{L}}\right]$

$e^{\frac{-Rt}{L}} = \frac{1}{2}$

$\Rightarrow \frac{tR}{L} = \ln 2$

$t = \frac{L}{R}\ln 2 = \frac{10 \times 10^{-3}}{5} \times 0.7 = 1.4$ milli second

CHEMISTRY

101.[C] Rate is governed by slowest step

$A + B_2 \underset{}{\overset{k_1}{\rightleftharpoons}} AB + B$

$r = k_1[A]\ [B_2]$ .....(i)

From $A_2 \overset{K_C}{\rightleftharpoons} A + A$

$k_C = \frac{[A]^2}{[A_2]}$ .....(ii)

$[A] = \sqrt{k_c}\ [A_2]^{1/2}$

$r = \sqrt{k_c}\ [A_2]^{1/2}\ [B_2]$

Order is $= \frac{1}{2} + 1 = \frac{3}{2}$

102.[A] Anode $Zn \rightarrow Zn^{2+} + 2e^-$

Cathode $2H^+ + 2e^- \rightarrow H_2$

Cell : $Zn + 2H^+ \rightleftharpoons H_2 + Zn^{2+}$

$E^0_{cell} = 0 - (-0.76) = 0.76$ V

$\therefore 0.701 = 0.76 - \frac{0.059}{2} \log \frac{0.01 \times 1}{[H^+]^2}$

$\therefore [H^+] = 10^{-2}$ M

$\therefore$ NaOH required is 0.01 mole = 0.4 gms.

103.[A] From the electronic configurations

104.[B] In a body centred lattice this position where the atom of maximum size can be fitted should not be lying on the edge centre as the distance between surface of two atoms which are at corners of a cube is very small so will be off the edge so will be at distance of $\left(\frac{a}{4}\right)$ from edge centre on $\perp$ bisector of edge of cube.

Hence we get

$$R + r = \sqrt{\frac{a^2}{u} + \frac{a^2}{16}} = \sqrt{\frac{5a^2}{16}}$$

$$= \sqrt{\frac{5}{16} \times \frac{16R^2}{3}}$$

So $r = \left(\sqrt{\frac{5}{3}} - 1\right) R$

$[4R = \sqrt{3}\, a]$

105.[D] Boiling point of solution

= boiling point + ΔT_b = 100 + ΔT_b

Freezing point of solution = freezing point − ΔT_f = 0 − ΔT_f

Difference in temperature (given)

= 100 + ΔT_b − (− ΔT_f)

104 = 100 + ΔT_b + ΔT_f

= 100 + molality × K_b + molality × K_f

= 100 + molality (0.52 + 1.86)

$\therefore$ Molality = $\frac{104 - 100}{2.38} = \frac{4}{2.38} = 1.68$ m

and molality = $\frac{moles \times 1000}{W_{gm(solvent)}}$;

$1.68 = \frac{moles \times 1000}{500}$

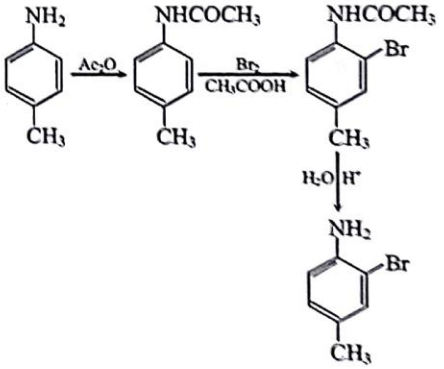
$\therefore$ Moles of solute = $\frac{1.68 \times 500}{1000}$

= 0.84 moles

106.[A] $\frac{1}{4}th$ reaction has completed upto 15 min. Hence

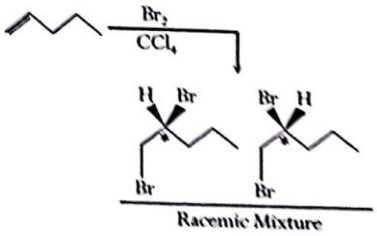
V_{KMnO_4} will be $\frac{3}{4} \times 40 = 30$ mL

107.[A]

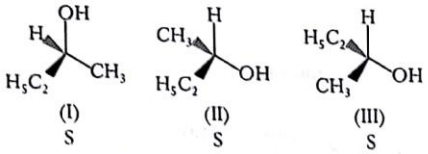


108.[A] The given reaction can taken place only by S_N1 hence statement 1, 2, 3 and 5 are correct

109.[D]



110.[B]



I and III are enantiomers

BIOLOGY

111.[C] Coxidised chlorophyll

112.[A] 2-celled stage

113.[B] 1 : 2 : 1

114.[A] *A*– female, *B*– meta female, *C*– male

115.[B] Change in single base pair

116.[B] Wheat and rye

117.[C] 3.3×10^9 bp

118.[B] Introns end exons are joined

119.[C] Operator

120.[B] Polymerase

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-8

Stream – SX

Hints & Solutions

Answer key

1.(C)	2.(A)	3.(A)	4.(D)	5.(A)	6.(C)	7.(D)	8.(C)	9.(D)	10.(A)	11.(D)	12.(C)	13.(A)	14.(C)	
15.(C)	16.(A)	17.(A)	18.(A)	19.(C)	20.(C)	21.(D)	22.(B)	23.(B)	24.(C)	25.(B)	26.(B)	27.(C)	28.(D)	
29.(C)	30.(B)	31.(C)	32.(D)	33.(B)	34.(B)	35.(B)	36.(A)	37.(D)	38.(C)	39.(C)	40.(A)	41.(D)	42.(B)	
43.(A)	44.(D)	45.(A)	46.(A)	47.(A)	48.(A)	49.(C)	50.(A)	51.(C)	52.(D)	53.(D)	54.(D)	55.(A)	56.(C)	
57.(B)	58.(D)	59.(A)	60.(A)	61.(D)	62.(B)	63.(C)	64.(B)	65.(A)	66.(C)	67.(A)	68.(A)	69.(B)	70.(D)	
71.(B)	72.(A)	73.(B)	74.(C)	75.(B)	76.(B)	77.(B)	78.(C)	79.(B)	80.(D)	81.(A)	82.(B)	83.(A)	84.(A)	
85.(B)	86.(A)	87.(C)	88.(A)	89.(B)	90.(C)	91.(C)	92.(C)	93.(D)	94.(B)	95.(B)	96.(B)	97.(C)	98.(B)	
99.(A)	100.(A)	101.(D)	102.(A)	103.(B)	104.(B)	105.(B)	106.(D)	107.(C)	108.(C)	109.(B)	110.(C)	111.(C)	112.(C)	
113.(D)	114.(D)	115.(B)	116.(B)	117.(D)	118.(C)	119.(C)	120.(C)							

PART-I [One Mark Questions]

MATHEMATICS

1.[C] Equation of a line parallel to x-axis and passes through $P(2, -3, 4)$

$\frac{x-2}{1} = \frac{y+3}{0} = \frac{z-4}{0} = \lambda$

Point on it $(\lambda + 2, -3, 4)$

It will satisfy plane

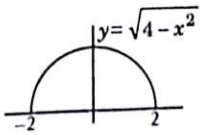
$(\lambda + 2) - 3 + 4 = 5$

$\lambda = 2$

Point on plane $Q(+4, -3, 4)$

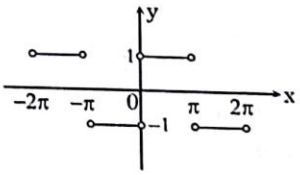
Hence dis $PQ = 2$

2.[A] $y = \sqrt{4 - x^2}$



$$< y >_{avg} = \frac{\int_{-2}^{2} \sqrt{4 - x^2}\, dx}{4} = \frac{\frac{\pi(2)^2}{2}}{4} = \frac{\pi}{2}$$

3.[A]



4.[D] cont. for all real numbers

5.[A] Use $c_2 \to c_2 + 2\cos x\, c_3$

$\Rightarrow f(x) = 2$

$\Rightarrow f'(x) = 0$

6.[C] $R_1 \to R_1 - R_2$ and $R_2 \to R_2 - R_3$

7.[D] $f(x) = -x^3 + 2ax^2 - 3bx + c$

$f'(x) = -3x^2 + 4ax - 3b \le 0 \quad \forall\, x$ if

$16a^2 - 36b \le 0$

$4a^2 \le 9b \quad \therefore k \ge 9$

8.[C] $\because\ x > 3$ so $\ell n\, x > \ell n\, 3 > 1$

So $\sin^{-1}(\ell n\ x)$ & $\cos^{-1}\ \ell n\ x$ are not define.

Hence the given integral does not exist

9.[D] $x > 0\ \cot^{-1} x = t$

$t \in \left(\frac{\pi}{2}, \pi\right)$

$\cot t = x$

$\tan t = \frac{1}{x}$

$\tan^{-1}\tan t = \tan^{-1}\frac{1}{x}$

$t - \pi = \tan^{-1}\frac{1}{x}$

$-\pi + \cot^{-1} x = \tan^{-1}\frac{1}{x}$

10.[A] $L = \underset{x\to\infty}{Limit}\frac{\ell n[x]}{x}$

$\underset{x\to\infty}{Limit}\frac{\ell n[x]}{x} \le L \le \underset{x\to\infty}{Limit}\frac{\ell nx}{x}$

$\underset{x\to\infty}{Limit}\left(\frac{1}{x-1} \le L \le \frac{1}{x}\right)$

$\Rightarrow 0 \le L \le 0$

$\Rightarrow L = 0$

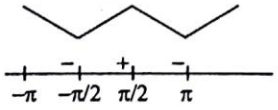
11.[D] $f'(x) = -2\sin 2x + 2p\cos x$

$f'(x) = -2\cos x\,(2\sin x - p)$

Since $p > 2$

$\Rightarrow 2\sin x - p < 0$

Hence $f'(x)$ will have same sigh as $\cos x$



Hence maximum value is at $x = \frac{\pi}{2}$ which is equal to $-1 + 2p$

12.[C] $\phi'(x) = 2\,f(x)\,.\,f'(x)$; if $f(x) > 0$ in (a, b) then $\phi'(x) > 0$ and if $f(x) < 0$ in (a, b) then $\phi'(x) < 0$

$\Rightarrow C$

13.[A] Number of equilateral triangles = 8

Number of isosceles triangles = 32

$\therefore\ p = \frac{1}{4}$

$\therefore\ 840\,p = 210$

14.[C] Put $x = 0$, $b^2 = \cos b^2 - 1$

or $\cos b^2 = 1 + b^2$

$\Rightarrow\ b = 0$

Now the equation becomes

$$-2a\sin^2\frac{x}{2} = \cos ax - 1 = -2\sin^2\frac{ax}{2}$$

or $a\sin^2\frac{x}{2} = \sin^2\frac{ax}{2}$

must be true $\forall\, x \in R$

$\Rightarrow\ a = 0$ or $a = 1$

15.[C] $\alpha_n = \frac{a+b}{2}$, $\beta_n = \sqrt{ab}$, $\gamma_n = \frac{2ab}{a+b}$

$\therefore$ the equation is

$$\frac{a+b}{2}x^2 - \sqrt{ab}x + \frac{2ab}{a+b} = 0$$

Its discriminate $D < 0$

$\therefore$ The roots are imaginary

16.[A] $x = \underset{c\to 1}{Limit}\frac{5(c-1)(c+1)}{5(c-1)(3c+2)} = \frac{2}{5}$;

$y = \underset{c\to 1}{Limit}\frac{1-c}{5(c-1)(3c+2)} = -\frac{1}{25}$

17.[A] $\frac{1}{x_1} = p = \frac{y_1}{x_1}$

$\Rightarrow y_1 = 1$ & $x_1 = e$

Hence slope of $y = px$

i.e. $p \in \left(0, \frac{1}{e}\right)$ for three roots

18.[A] If $\sin x > 0$

$\Rightarrow \sin x = \sin x + 3$

$\Rightarrow$ Not possible

If $\sin x < 0$

$\Rightarrow -\sin x < 0$

$\Rightarrow -\sin x = \sin x + 3 = 1$

$\sin x = -\frac{3}{2}$ not possible

19.[C] $5\alpha = 2\alpha + 3\alpha$

Take tangent both side

$\Rightarrow \tan 5\alpha = \frac{\tan 2\alpha + \tan 3\alpha}{1 - \tan 2\alpha \tan 3\alpha}$

$\Rightarrow \tan 5\alpha - \tan 2\alpha \,.\, \tan 3\alpha \,.\, \tan 5\alpha = \tan 2\alpha + \tan 3\alpha$

$\therefore -1 = \frac{\tan 2\alpha + \tan 3\alpha - \tan 5\alpha}{\tan 2\alpha . \tan 3\alpha . \tan 5\alpha}$

20.[C] $\vec{p}.\vec{q} = 0$ & $\vec{r}.\vec{s} = 0$.

Form two simultaneous equations and get a relation between $|\vec{a}|$ & $|\vec{b}|$ as $25|\vec{a}|^2 = 43|\vec{b}|^2$.

Now compute $\cos(\vec{a} \wedge \vec{b}) = \frac{\vec{a} \,.\, \vec{b}}{|\vec{a}||\vec{b}|}$

PHYSICS

21.[D] Acceleration due to gravity $= \frac{GM}{r^2}$ where r is distance from centre of earth

$$g_h = \frac{GM}{(R+h)^2} = \frac{GM}{R^2\left[1+\frac{h}{R}\right]^2}$$

put $\frac{GM}{R^2} = g$

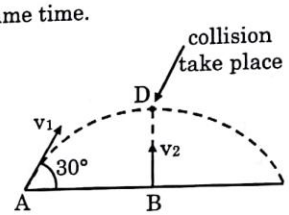
$$g_h = \frac{g}{(1+h/R)^2}$$

$\Rightarrow (1 + h/R)^2 = \frac{g}{g/9} = 9 \Rightarrow 1 + \frac{h}{R} = 3$

$\Rightarrow h = 2R$

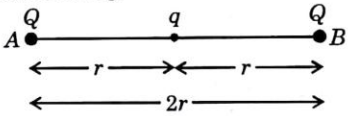
22.[B] Vertical displacement for both is same when they collide

B is moving in vertical line and will move in this line. where A is moving along projectile path. A can collide only at its highest point (D) both should reach D at same time.



$\frac{v_1 \sin 30}{g} = \frac{v_2}{g} \Rightarrow \frac{v_1}{v_2} = \frac{2}{1} \Rightarrow \frac{v_2}{v_1} = 0.5$

23.[B] Refer to Fig.



The three charges will be in equilibrium if no net force acts on each charge. The charge q is in equilibrium because the forces exerted on q by charge Q at A and charge Q at B are equal and opposite. The charge Q at A will be in equilibrium if the forces exerted on it by charge q and charge Q at B are equal and opposite, i.e. if

$$\frac{qQ}{4\pi\varepsilon_0 r^2} = -\frac{Q \times Q}{4\pi\varepsilon_0 (2r)^2}$$

or $q = -\frac{Q}{4}$

Similarly, charge Q at B will be in equilibrium if $q = -\frac{Q}{4}$. Hence the correct choice is (2).

24.[C] Particle has acceleration which is retardation acceleration $= -bV^2$

$a = -bV^2$

$\frac{dV}{dt} = -bV^2$

$\int_U^V \frac{dV}{V^2} = \int_o^t b\,dt$

$+\frac{1}{V}\Big]_U^V = +bt$

$\frac{1}{V} - \frac{1}{U} = bt$

$\frac{1}{V} = bt + \frac{1}{U}$

$V = \frac{U}{Ubt+1}$

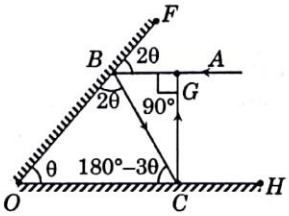
$\frac{ds}{dt} = \frac{U}{Ubt+1}$

$\int ds = U\int_o^t \frac{dt}{Ubt+1}$

$S = \frac{U \times \ln[Ubt+1]}{Ub}$

$S = \frac{\ln[Ubt+1]}{b}$

25.[B]



$\angle\phi$ = angle that normal on the mirror OB make with AB

$\angle\phi = 90 - 2\theta$

By law of Reflection $\angle ABE = \angle OBC$

$2\theta = \angle OBC$

$\therefore \angle OBC = 2\theta$

$\angle ABC = 180 - (2\theta + 2\theta) = 180 - 4\theta$

in ΔBGC sum of all angle $= 180°$

$\angle BCG + \angle CGB + \angle GBC = 180°$

$\angle BCG + 90° + (180 - 4\theta) = 180°$... (1)

From ΔOBC

$\angle BCO = 180 - (\theta + 2\theta) = 180 - 3\theta$

By law of Reflection

$\angle BCO = \angle GCH$

$\angle GCH = 180 - 3\theta$

from linear pair

$\angle BCG = 180 - [180 - 3\theta + 180 - 3\theta]$

$\angle BCG = 6\theta - 180$ ... (2)

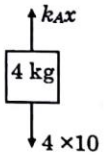
Put $\angle BCG$ value in (1)

$6\theta - 180 + 90 + 180 - 4\theta = 180$

$2\theta = 90 \Rightarrow \theta = 45°$

26.[B] When F is spring force and x is elongation in spring.

From equilibrium of 4 kg block



$k_{Ax} = 4 \times 10$

$\frac{k_A \times 1}{100} = 4 \times 10 \Rightarrow k_A = 4000$ N/m

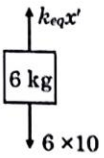
as each spring in identical

$\therefore \quad k_A = k_B = k_C = 4000$

spring B and C are joined in series combination

$\therefore \frac{1}{k_{eq}} = \frac{1}{k_B} + \frac{1}{k_C} = \frac{1}{4000} + \frac{1}{4000}$

$k_{eq} = 2000$

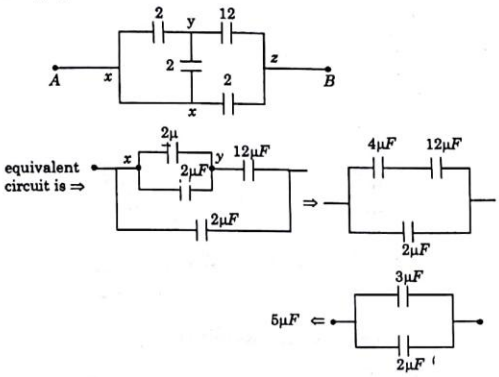


from equilibrium of 6 kg block

$k_{eq}x' = 6 \times 10 \Rightarrow 2000 \times x' = 6 \times 10$

$x' = \frac{3}{100} m \Rightarrow x' = 3$ cm

27.[C]



28.[D] Spring constant of spring

$$\propto \frac{1}{\text{length of spring}}$$

So when length is halved spring, spring constant get double

29.[C] m on sphere is not sliding on sphere

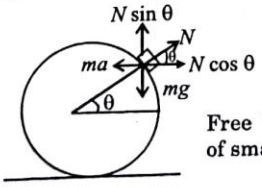
$\therefore$ We can say that sphere and block are moving together with common acceleration 'a'

Applying Newton law of motion $F = ma$ on system of sphere and block

$$F = (M+m)a$$

$$a = \frac{F}{M+m} \quad \ldots (1)$$

Block is at rest relative to sphere we write equation of NLM relative to sphere then we have to apply pseudo force on block as sphere is accelerating frame reference this pseudo force is applied in the direction opposite to direction of a. See the free body diagram



Free body diagram of small block m

By F.B.D of m

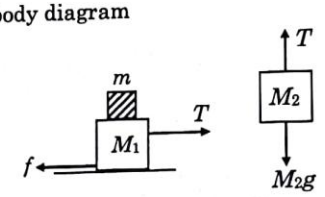
$N\sin\theta = mg$ and $N\cos\theta = ma$

$$\therefore \quad \tan\theta = \frac{g}{a} \Rightarrow a = g\cot\theta \quad \ldots(2)$$

From (1) and (2)

$F = (m + M)g\cot\theta$

30.[B] Free body diagram



As system does not accelerate

$\therefore$ Net force on each mass = 0

F_{net} on $M_2 = 0$

$M_2g - T = 0$

$\therefore \quad T = M_2g$

Net force on system of M_1 & m is zero

$T - f = 0$

$M_2g - f = 0$

$f = M_2g$

However fractional force have limiting value of μN.

Where $N = (M_1 + m)g$

$f \le \mu N$

$M_2g \le \mu(M_1 + m)g$

$$m \ge \frac{M_2}{\mu} - M_1$$

31.[C] In process pressure P is proportional to volume V.

As $P \propto V$

$\therefore \quad PV^{-1} = \text{constant}$

$\Rightarrow$ specific heat of gas for any process $= C = C_V + \frac{RT}{V}\frac{dV}{dT}$

for diatomic gas $C_V = \frac{5R}{2}$

$$\frac{P}{V} = C$$

From ideal gas equ. $P = \frac{nRT}{V}$

$$\frac{nRT}{V^2} = C$$

Taking log on both side and differentiating

$$\ell n(nR) + \ell nT - \ell nV^2 = \ell nC$$

$$\frac{dT}{T} - \frac{2VdV}{V^2} = 0$$

$$\frac{dV}{dT} = \left(\frac{V}{T}\right)\frac{1}{2}$$

$$C = \frac{5R}{2} + \frac{RT}{V} \times \frac{V}{T} \times \frac{1}{2}$$

$$= \frac{5R}{2} + \frac{R}{2} \Rightarrow 3R$$

But as rms speed is doubled therefore temperature becomes four times.

So, $T_f = 4T_i$

Heat supply $Q = nC\Delta T = n \times 3R(T_f - T_i)$

$= n \times 3R(4T_i - T_i)$

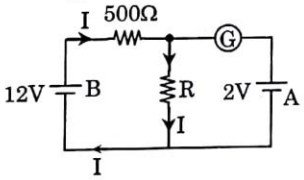
$= 9\, nRT_i = 9\, P_1V_1$

32.[D] Reading in G is zero when potential on R is equal to 2V

$$I = \frac{12}{500 + R} \quad \ldots (1)$$

also $IR = 2V$ ... (2)

from (1) & (2)



$$\frac{12R}{500 + R} = 2$$

$12R = 1000 + 2R$

$10R = 1000$

$R = 100\ \Omega$

33.[B] Adiabatic compressibility of gas is given by $\frac{1}{\gamma P}$

where P is pressure of gas and γ is adiabatic coefficient of expansion of gas.

$dQ = -dU$

$$C = -C_V = \frac{-R}{\gamma - 1} = \frac{+R}{\gamma - 1} + \frac{P}{n}\frac{dV}{dT}$$

$$\boxed{-\frac{P}{n}\frac{dV}{dT} = \frac{2R}{\gamma - 1}}$$

$TV^5 = \text{const.}$

$$V = \frac{\text{const.}}{T^5}$$

$$\frac{dV}{dT} = -5\frac{\text{const.}}{T^6}$$

$PV = nRT$

$P/n = RT/V$

$$+ \frac{RT}{\text{const.}}T^5 \times \left(-5\frac{\text{const}}{T^6}\right) = \frac{2R}{\gamma - 1}$$

$$\frac{5}{2} = \frac{1}{\gamma - 1} \Rightarrow \gamma - 1 = 2/5$$

$\gamma = 7/5$

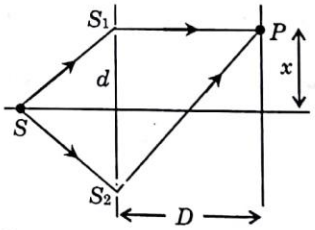
adiabatic compressibility

$$\beta = \frac{1}{\gamma P} = \frac{5}{7P}$$

34.[B] All are in series therefore current remains same. Hence temperature difference = (current × thermal resistance) are equal for every case.

35.[B] Only outside the pipe.

36.[A]



$I_0 = I_0 + I_0 + 2I_0 \cos\phi$

$$\cos\phi = -\frac{1}{2}$$

$$\phi = \frac{2\pi}{3}$$

$$\phi = \frac{2\pi}{\lambda}\Delta x$$

$$\frac{2\pi}{3} = \frac{2\pi}{\lambda}\Delta x$$

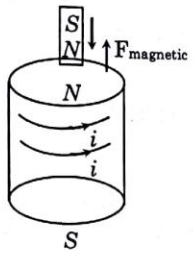
$$\Delta x = \frac{\lambda}{3}$$

$$\frac{dx}{D} = \frac{\lambda}{3}$$

$$x = \frac{\lambda D}{3d} = \frac{6000 \times 10^{-10}}{3} \times 10^4$$

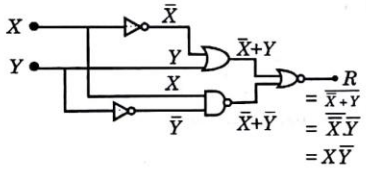
$\Rightarrow 2 \times 10^{-3}$ metre $\Rightarrow 2$ mm

37.[D]



Finally due to eddy current in cylinder magnetic force will act on magnet. Magnet move with steady velocity as velocity is constantly acceleration of magnet is zero.

38.[C]



* Out put $R = X\,\bar{Y}$
* If $R = 1$ it is possible when $X = 1$ & $Y = 0$

39.[C] Moseley's law

$\sqrt{\nu} \propto Z - 1$

$\nu \propto (Z-1)^2$

$\frac{C}{\lambda} \propto (Z-1)^2$

$\frac{\lambda_C}{\lambda_M} = \frac{(Z_M - 1)^2}{(Z_C - 1)^2}$

$\lambda_C = 0.71 \times \frac{41^2}{28^2} = 1.52$ Å

40.[A] $y = 4 \sin\left(\frac{\pi x}{15}\right)\cos(96\pi t)$ ....(1)

$y = 2a \sin kx \cos \omega t$ ....(2)

from comparison 1 & 2

$k = \frac{\pi}{15} = \frac{2\pi}{\lambda}$

$\lambda = 30$

Distance between nearest node and Antinode = $\lambda/4$

$= \frac{30}{4} = 7.5$ unit

CHEMISTRY

41.[D] Time taken for 25% completion

$C_t = C_0 e^{-1} k_1 t_1$

$\Rightarrow \frac{3}{4} = e^{-k_1 t_1}$

as $\ln(3/4) = k_1 b_1$ so $t_1 = \frac{1}{k_1} \ln\left(\frac{4}{3}\right)$.

Time taken for 75% completion $t_2 = 2.\frac{In2}{k_2}$

So required ratio $\frac{t_1}{t_2} = \frac{In(4/3)k_2}{k_1 . 2In2}$

$= \frac{3}{2} \times \frac{(In4 - In3)}{In4}$

$= 0.3 : 1$

42.[B]

	$4A(g)$	$\longrightarrow$	$B(g)$	+	$2C(g)$
$t = 0$	800		–		–
$t = 10$ min,	$800 - 4p$		p		$2p$

$800 - p = 650$

$\therefore p = 150$

Pressure of $A = 200$, so

$\therefore \quad 2 \times t_{1/2} = 10$ minutes

$t_{1/2} = 5$ minutes

43.[A] Composed is a neutral molecule so there should not be potassium cation

44.[D] (A) $[Cu(NH_3)_4]^{2+} = 29 - 2 + 8 = 35$

$[Fe(CN)_6]^{3-} = 26 - 3 + 12 = 35$

(B) $[Fe(CN)_6]^{4-} = 26 - 2 + 12 = 36$

$[Co(NH_3)_6]^{3+} = 27 - 3 + 12 = 36$

(C) $[Cr(C_2O_4)_3]^{3-} = 27 - 3 + 12 = 36$

$[Ni(CO)_4] = 28 + 8 = 36$

45.[A] Quinol is acting as an acid it is donating H^+ ions

46.[A] $2HSO_4^- \longrightarrow S_2O_8^- + 2H^+ + 2e^-$

So required rate = 1 mole / hr

= 2 mole of e^-/hr

$= \frac{2 \times 96500\ C}{3600\ \text{sec}}$

$= \frac{2 \times 965}{36} A \simeq 53.6A$

So required current = $\frac{4}{3} \times 53.6$ A

= 71.4 A

47.[A] $CrO_2Cl_2 + 4NaOH \rightarrow Na_2CrO_4(A) + 2NaCl + 2H_2O$

$Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7(B) + Na_2SO_4 + H_2O$

$Na_2Cr_2O_7 + NaOH \rightarrow Na_2CrO_4(C) + H_2O$

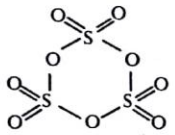
$Na_2CrO_4 + 2AgNO_3 \rightarrow Ag_2CrO_4(D) + 2NaNO_3$

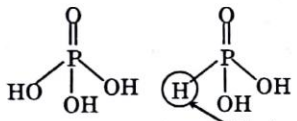
48.[A] Shown arrangement is hexagonally closed pack plane & these type of planes are arranged perpendicular to body diagonal of fcc unit cell as shown

49.[C] $2KI + HgI_2 \rightarrow K_2[HgI_4]$

50.[A] According Hardy-Schulze rule

51.[C] $[CO_4]^{-4}$ does not exist

52.[D]  Hence , Ans (D)

53.[D] 

H_3PO_4 H_3PO_3

Strength of phosphorous oxy acid depends upon the number of OH groups per P = O group, It is the P = O group which induce polarization and help in the release of proton from –OH group.

54.[D] Hofmann mustard oil reaction

55.[A] Both I and II have activated aromatic nucleus, hence tribromo substitution product is formed with I and II.

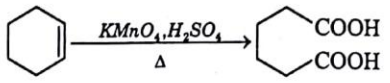
56.[C] Acid strength order

$HClO_4 > HCl > CH_3COOH > NH_3$

Conjugate base strength order

$ClO_4^- < Cl^- < CH_3COO^- < NH_2^-$

57.[B] Here Br^- is incoming nucleophile and OH_2^+ is leaving nucleophilic group

58.[D] 

59.[A] It is ArS_E2 reaction, N has lone pair so it is activating and subtitutions accurs at most activated position.

60.[A] Anti form of butane is more stable because of less strains

BIOLOGY

61.[D] All

62.[B] Pituitary

63.[C] Glucose, aceto acetate, vitamins

64.[B] Vaccination

65.[A] Homologous to penis

66.[C] Both

67.[A] cephalothorax, biramous appendages and gills

68.[A] Seminal vesicle

69.[B] IgG

70.[D] parthenogenesis

71.[B] Complete medium and streptomycine

72.[A] Gene bank

73.[B] Harmful and recessive

74.[C] In the eight cell stage, cells are separated and cultured until small embryos are formed which are implanted into the womb of other cows.

75.[B] Goat

76.[B] Sporophyte

77.[B] *Cycas*

78.[C] Small cells have a large surface area per volume ratio

79.[B] A – mitosis; B– meiosis

80.[D] I, II, III and IV

PART-II [Two Marks Questions]

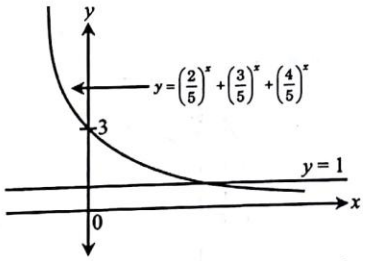
MATHEMATICS

81.[A] $2^x + 3^x + 4^x - 5^x = 0 \Rightarrow 2^x + 3^x + 4^x = 5^x$

$$\Rightarrow \left(\frac{2}{5}\right)^x + \left(\frac{3}{5}\right)^x + \left(\frac{4}{5}\right)^x = 1$$

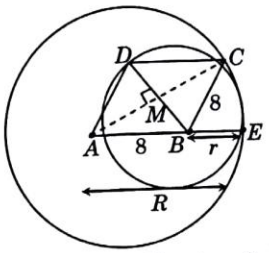
Now, the number of solution the equation is equal to number of times

$y = \left(\frac{2}{5}\right)^x + \left(\frac{3}{5}\right)^x + \left(\frac{4}{5}\right)^x$ and $y = 1$ intersect.



From the graph, the equation has only one solution.

82.[B]



$\therefore$ Diagonals of rhombus bisects each other

Let $AC = R$

$\therefore$ $AM = R/2$

Also let $BE = r = BD$

$\therefore$ $DM = r/2$

$\therefore$ Area of rhombus $= \frac{1}{2}(AC.BD) = \frac{Rr}{2}$ ....(1)

$\therefore$ In ΔAMD

$$8^2 = \left(\frac{R}{2}\right)^2 + \left(\frac{r}{2}\right)^2$$

$$R^2 + r^2 = 256 \quad \text{.... (2)}$$

Now $AB = R - r = 8$

Squaring

$$R^2 + r^2 - 2Rr = 64 \quad \text{.... (3)}$$

(2) – (3)

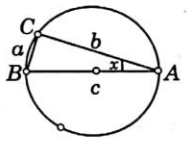
$$2Rr = 192$$

$$\therefore \frac{Rr}{2} = 48 \text{ sq. unit}$$

83.[A] Since, $a^2 + b^2 = c^2 = 4r^2$ ...(i)

Also, $\frac{1}{2}a.b = \frac{2\pi r^2}{9}.\frac{1}{2}$

$\Rightarrow 9ab = 2\pi r^2$ ...(ii)



From Eqs. (i) and (ii), we get

$$\frac{a^2+b^2}{9ab} = \frac{2}{\pi} \Rightarrow \frac{a}{b} + \frac{b}{a} = \frac{18}{\pi}$$

Let $\angle BAC$, then $\frac{\cos x}{\sin x} + \frac{\sin x}{\cos x} = \frac{18}{\pi}$

$$\Rightarrow \frac{\cos^2 x + \sin^2 x}{\sin x.\cos x} = \frac{18}{\pi}$$

$$\Rightarrow \sin x \,.\, \cos x = \frac{\pi}{18}$$

$$\sin 2x = \frac{\pi}{9}$$

84.[A] Divide by $\cos^4\alpha$

$\Rightarrow 15\tan^4\alpha + 10 = 6\sec^4\alpha$

$\Rightarrow 15\tan^4\alpha + 10 = 6(1 + \tan^2\alpha)^2$

$\Rightarrow (3\tan^2\alpha - 2)^2 = 0$

$\therefore \tan^2\alpha = 2/3$

Now $8(1+\cot^2\alpha)^3 + 27(1+\tan^2\alpha)^3 - 241 = 9$

85.[B] $a \le \sin A$

$\Rightarrow R \le \frac{1}{2}$

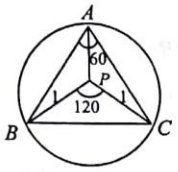
$\Rightarrow x^2 + y^2 < \frac{1}{4}$

Now A.M. $\ge$ G.M.

$|xy| \le \frac{x^2+y^2}{2} < \frac{1}{8}$

$\Rightarrow k > 1 \quad \therefore k = 2$

86.[A]



Let R_1 is circumradius of ΔBPC

$\therefore \frac{a}{\sin 120^\circ} = 2R_1 \quad \ldots\ldots (i)$

Also for ΔABC

87.[C] $A = \sin x + \cos\left(x - \frac{\pi}{4}\right) + \sqrt{2+\sqrt{2}}$

$A = \sin x + \left(\cos x \cos\frac{\pi}{4} + \sin x \sin\frac{\pi}{4}\right) + \sqrt{2+\sqrt{2}}$

$A = \left(1 + \frac{1}{\sqrt{2}}\right)\sin x + \frac{1}{\sqrt{2}}\cos x + \sqrt{2+\sqrt{2}}$

The maximum value of

$A = c + \sqrt{a^2+b^2} = \sqrt{2+\sqrt{2}} + \sqrt{\left(1+\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2}$

$= \sqrt{2+\sqrt{2}} + \sqrt{1+\frac{1}{2}+\sqrt{2}+\frac{1}{2}} = 2\sqrt{2+\sqrt{2}}$

So, $0 \le A \le 2\sqrt{2+\sqrt{2}}$.

88.[A] $T_n = \frac{n}{1+n^2+n^4} = \frac{n}{(1+n^2)^2 - n^2}$

$= \frac{n}{(1+n^2-n)(1+n^2+n)}$

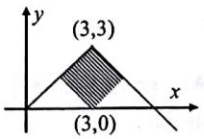
$= \frac{1}{2}\left(\frac{1}{1+n^2-n} - \frac{1}{1+n^2+n}\right) \quad \ldots (1)$

$S_n = \sum_{r=1}^{n} t_r = \frac{1}{2}$

$\left(1 - \frac{1}{3} + \frac{1}{3} - \frac{1}{7} + \ldots\ldots + \frac{1}{1+n^2-n} - \frac{1}{1+n^2+n}\right)$

$\Rightarrow S_n = \frac{1}{2}\left(1 - \frac{1}{1+n^2+n}\right) = \frac{n(n+1)}{2(n^2+n+1)}$

89.[B] Required area $= \frac{3}{\sqrt{2}} \times \frac{3}{\sqrt{2}} = \frac{9}{2}$



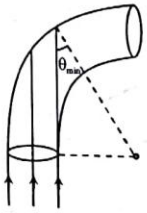
90.[C] $Arg\left\{\frac{1}{(i^4)^{13}i} + (i^n + i.i^n - i^n - i.i^n + 4)i\right\}$

$Arg\{-i + 4i\} = Arg(3i) = \frac{\pi}{2}$

PHYSICS

91.[C] $\theta_{min} > C$

$\sin\theta_{min} > \sin C$



$\frac{R-d}{R} > \frac{1}{n}$

$\Rightarrow Rn - dn > R$

$\Rightarrow R > \frac{nd}{n-1}$

$R > \frac{2.4}{2-1}$ mm

$R > 8$ mm

92.[C] $i = \frac{dq}{dt}$ = Slope of q - t graph

$= -5$ (which is constant)

Amount of heat generated in time t

$= i^2RT \propto t$.

93.[D] The intensity distance x-from central order bright on screen is

$$I = I_0\cos^2\frac{\pi x}{\beta}$$

where I_0 = maximum intensity, β = fringe width

$$\text{If } I = \frac{3}{4}I_0 \Rightarrow \cos\frac{\pi x}{\beta} = \frac{\sqrt{3}}{2} = \cos\frac{\pi}{6}$$

$$\therefore x = \frac{\beta}{6}$$

Hence the required distance

$$= 2 \times \frac{\beta}{6} = \frac{\beta}{3} = 0.20 \text{ mm}$$

94.[B] The peak value of the current is

$$I_0 = \frac{V_0}{\sqrt{R^2 + \frac{1}{\omega^2C^2}}} = \frac{V_0}{\sqrt{2}R}$$

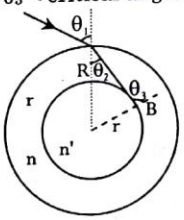
When the angular frequency is changed to $\frac{\omega}{\sqrt{3}}$

The new peak value is

$$I_0' = \frac{V_0}{\sqrt{R^2 + \frac{3}{\omega^2C^2}}} = \frac{V_0}{\sqrt{4R^2}} = \frac{V_0}{2R}$$

$$\therefore I_0' = \frac{I_0}{\sqrt{2}}$$

95.[B] For all rays to enter liquid maximum value of θ_3 < critical angle



$$\therefore \quad \sin\theta_{3\max} < \frac{n'}{n} \qquad \text{.....(1)}$$

Applying sine rule to ΔABC

$$\frac{\sin\theta_2}{r} = \frac{\sin(\pi - \theta_3)}{R} = \frac{\sin\theta_3}{R}$$

$\therefore$ θ_3 is maximum when θ_2 is maximum

$$\Rightarrow \quad \frac{\sin\theta_{2\max}}{r} = \frac{\sin\theta_{3\max}}{R} \qquad \text{.....(2)}$$

$$\text{Also } \sin\theta_{2\max} = \frac{1}{n} \qquad \text{.....(3)}$$

From (1), (2) and (3) $r > \frac{R}{n'}$

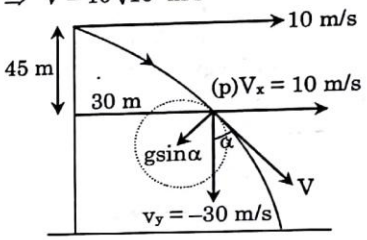
96.[B] Method (I)

After 3 sec

$V_y = u_y + gt = -30$ m/s

and $V_x = 10$ m/s $\quad \therefore V^2 = V_x^2 + V_y^2$

$$\Rightarrow \quad V = 10\sqrt{10} \text{ m/s}$$



Now, $\tan\alpha = \frac{V_x}{V_y} = \frac{1}{3}$

$$\Rightarrow \quad \sin\alpha = \frac{1}{\sqrt{10}}$$

Radius of curvature $r = \frac{V_\perp^2}{g\sin\alpha}$

$R = 100\sqrt{10}$ m

Method (II)

Let horizontal and vertical position of point p be x and y respectively

$$\therefore \quad x = Vt \text{ and } y = \frac{1}{2}gt^2$$

$$\therefore \quad \text{equation of trajectory } y = \frac{gx^2}{2V^2}$$

$$\therefore \quad \frac{dy}{dx} = \frac{gx}{V^2} \text{ and } \frac{d^2y}{dx^2} = \frac{g}{V^2}$$

$$\text{Radius of curvature } r = \frac{\left\{1 + \left(\frac{dy}{dx}\right)^2\right\}^{3/2}}{\frac{d^2y}{dx^2}}$$

$$= \frac{\left(1 + \frac{g^2x^2}{v^4}\right)^{3/2}}{g/v^2}$$

Now after 3 s ; $x = V_t = 30$ m

and $V = 10$ m/s $\quad \therefore r = 100\sqrt{10}$ m

97.[C] Impulse = change in momentum

$$\frac{\pi F_0 T}{4} = mu - 0 \; ; \; u = \frac{\pi F_0 T}{4m}$$

98.[B] $E_x = -\frac{\partial v}{\partial x} = -4x \; ; \; E_y = \frac{\partial v}{\partial y} = +3$

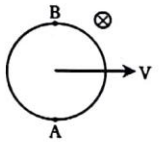
$$\vec{E} = E_x\hat{i} + E_y\hat{j} = -4x\hat{i} + 3\hat{j} = 3\hat{j} \text{ N/C}$$

99.[A] Consider the diametrical opposite points, A and B then $|e| = 2RBV$

Alternative solution

Maximum length of a rod perpendicular to v & B is $2R$

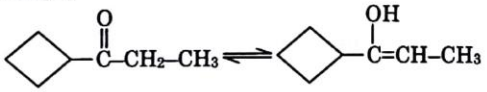
$\therefore \; E_{max} = B\,2RV$



100.[A] The charge of the plates cannot change because the plates are isolated. Inserting the dielectric changes the capacitance and therefore changes the potential difference (from $V = Q/C$), since the charge is fixed.

CHEMISTRY

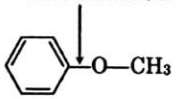
101.[D]



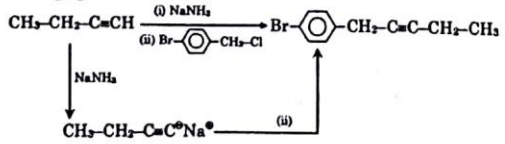
→ It show G.I. restricted rotation and two different group at each carbon

→ No C.C.

This bond do not break due to double bond

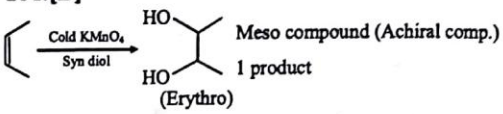


102.[A]

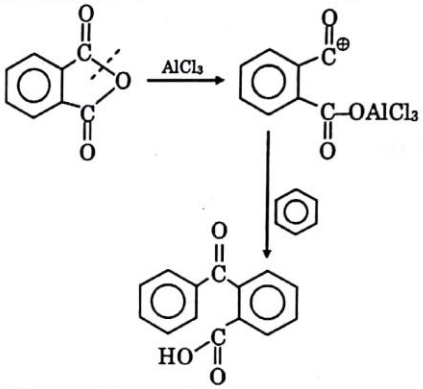


103.[B] $Ph{-}O{-}CH_3 \xrightarrow[excess]{conc.HI} Ph-\overset{18}{O}-H + CH_3-I$

104.[B]

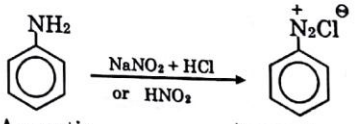


105.[B] This is example of Friedel Craft reaction in which anhydride is used for Acylation.



106.[D] Power of attraction force in polymer is weakest in Elastomer and rubber is Elastomer.

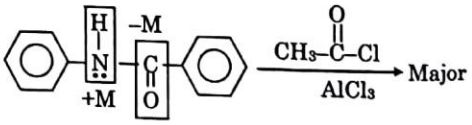
107.[C]



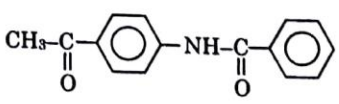
Aromatic 1° amine

Arene diazonium salt

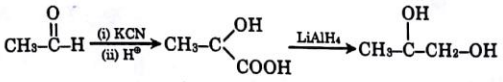
108.[C]



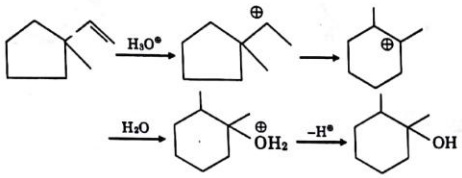
E^+ is $CH_3-\overset{\oplus}{C}=O$, it will attack on the ring which is more activating, So product is -



109.[B]



110.[C]



BIOLOGY

111.[C] 20 Jule & 40%

112.[C] Rough endoplasmic reticulum, protein synthesis

113.[D] Codominance

114.[D] two stranded helix where each strand has opposite polarity

115.[B] A-transcription B-Translation C-Francis Crick

116.[B] a, b & c

117.[D] None of these

118.[C] a, c, d

119. [C] Activated sludge-sediment in settlement tanks of sewage treatment plant is rich source of aerobic bacteria

120. [C] Nephridia of earthworm and Malpighian tubules of cockroach - excretory organs.

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-9

Stream – SX

Hints & Solutions

Answer key

1.(A)	2.(B)	3.(B)	4.(A)	5.(D)	6.(C)	7.(A)	8.(C)	9.(A)	10.(A)	11.(B)	12.(B)	13.(A)	14.(C)	
15.(A)	16.(C)	17.(C)	18.(B)	19.(B)	20.(B)	21.(C)	22.(D)	23.(D)	24.(A)	25.(A)	26.(A)	27.(A)	28.(C)	
29.(C)	30.(A)	31.(A)	32.(C)	33.(C)	34.(A)	35.(B)	36.(C)	37.(A)	38.(D)	39.(A)	40.(C)	41.(A)	42.(B)	
43.(B)	44.(A)	45.(A)	46.(B)	47.(C)	48.(A)	49.(A)	50.(A)	51.(D)	52.(B)	53.(D)	54.(B)	55.(A)	56.(A)	
57.(C)	58.(D)	59.(D)	60.(C)	61.(C)	62.(A)	63.(C)	64.(B)	65.(C)	66.(D)	67.(C)	68.(A)	69.(C)	70.(D)	
71.(B)	72.(B)	73.(C)	74.(C)	75.(B)	76.(A)	77.(C)	78.(D)	79.(A)	80.(A)	81.(A)	82.(A)	83.(D)	84.(B)	
85.(C)	86.(C)	87.(C)	88.(B)	89.(B)	90.(D)	91.(A)	92.(B)	93.(B)	94.(B)	95.(D)	96.(C)	97.(C)	98.(B)	
99.(C)	100.(C)	101.(C)	102.(A)	103.(C)	104.(C)	105.(B)	106.(B)	107.(C)	108.(B)	109.(C)	110.(B)	111.(C)	112.(B)	
113.(C)	114.(B)	115.(D)	116.(A)	117.(C)	118.(A)	119.(B)	120.(C)							

PART-I [One Mark Questions]

MATHEMATICS

1.[A] $2222 = 317 \times 7 + 3 = 7n - 4$

$5555 = 793 \times 7 + 4 = 7m + 4$

$(7n-4)^{5555} + (7m+4)^{2222}$

$= 7p - 4^{5555} + 7q + 4^{2222}$

$= 7I - 2^{11110} + 2^{4444}$

$= 7I - 2.8^{3703} + 2.8^{1481}$

$= 7I - 2(7x+1) + 2(7y+1)$

$= 7k$

2.[B] Let $z = \cos\theta + i\sin\theta$

$$\sqrt{(\cos\theta+\cos\alpha)^2+(\sin\theta+\sin\alpha)^2} + \sqrt{(\cos\theta-\cos\alpha)^2+(\sin\theta-\sin\alpha)^2}$$

$$= \sqrt{2+2\cos(\theta-\alpha)} + \sqrt{2-2\cos(\theta-\alpha)}$$

$$= 2\left|\cos\left(\frac{\theta-\alpha}{2}\right)\right| + 2\left|\sin\left(\frac{\theta-\alpha}{2}\right)\right|$$

$= 2(|\cos t| + |\sin t|) \le 2\sqrt{2}$

3.[B] We have $x_k + k = S - x_k$

where $x_1 + x_2 + ... + x_k = S$

$\Rightarrow 2xk + k = S$

$$\Rightarrow 2(S) + \frac{50.51}{2} = 50\,S$$

$$\Rightarrow 48(S) = 25.51$$

$$\Rightarrow x_{20} = \left(\frac{25.51}{48} - 20\right)\frac{1}{2} = \frac{315}{96}$$

4.[A] $(5 + 3\cos\alpha)\sin\theta - 3\sin\alpha.\cos\theta + 3$

Max. value $= \sqrt{(5+3\cos\alpha)^2 + 9\sin^2\alpha} + 3 = 10$

$$\Rightarrow \cos\alpha = \frac{1}{2}$$

5.[D] $\sum \frac{a}{\tan a} = 2R(\cos A + \cos B + \cos C)$

$= 2R\left[2\cos\frac{A+B}{2}.\cos\frac{A-B}{2} + 1 - 2\sin^2\frac{C}{2}\right]$

$= 2R\left[1 + 2\sin\frac{C}{2}\left(\cos\frac{A-B}{2} - \cos\frac{A+B}{2}\right)\right]$

$= 2R\left[1 + 4\sin\frac{A}{2}.\sin\frac{B}{2}.\sin\frac{C}{2}.\right]$

$= 2R\left(1 + 4\sin\frac{A}{2}.\sin\frac{B}{2}.\sin\frac{C}{2}.\right)$

$= 2R + 2r = 22$

6.[C] $\vec{a}\times\vec{b} = -2\hat{i} + 2\hat{j} + \hat{k} \Rightarrow |\vec{a}\times\vec{b}| = 3$

$|\vec{c} - \vec{a}|^2 = 8 \Rightarrow |\vec{c}|^2 + |\vec{a}|^2 - 2\vec{a}.\vec{c} = 8$

$\Rightarrow |\vec{c}|^2 + 1 = 0 \Rightarrow |\vec{c}| = 1$

$|(\vec{a}\times\vec{b})\times\vec{c}| = |\vec{a}\times\vec{b}||\vec{c}|\sin 30° = \frac{3}{2}$

7.[A] Let $\vec{r} = (\hat{i} + 2\hat{j} - \hat{k}) + \lambda(\hat{i} + \hat{j} - 2\hat{k})$

Its projection on

$\vec{a} = \frac{\vec{a}.\vec{r}}{|\vec{a}|} = \frac{1}{\sqrt{6}}(2 + 2I - 2 - I - 1 - 2I)$

$\Rightarrow -\frac{(1+\lambda)}{\sqrt{6}} = \pm\sqrt{\frac{2}{3}} \Rightarrow \lambda = 1, -3$

$\vec{r} = 2\hat{i} + 3\hat{j} - 3\hat{k}$ or $-2\hat{i} - \hat{j} + 5\hat{k}$

8.[C] $f(k + x) = f(k - x)$

Put $x \to k - x$

$f(2k - x) = f(x)$

So, $f(x) = -f(2k + x)$ .....(1)

$x \to x + 2k$

$f(x + 2k) = -f(x + 4k)$

So, $f(x) = f(x + 4k)$

Thus $f(x)$ is periodic.

Again, $f(2k-x) = f(x) \Rightarrow f(2k + x) = f(-x)$

From (1), $f(x) = -f(-x)$

Hence f is odd and periodic.

9.[A] $\lim_{x\to 0}\left(1 + \frac{p(x)}{x^2}\right) = 2$

$\Rightarrow \lim_{x\to 0}\frac{p(x)}{x^2} = 1$

Let $P(x) = a_0x^4 + a_1x^3 + a_2x^2 + a_3x + a_4$.

The given limit is finite is possible only if

$a_3 = a_4 = 0$ and is 1 if $a_2 = 1$

$\Rightarrow P(x) = a_0x^4 + a_1x^3 + x^2$

$P(x)$ has extremum at

$x = 1, 2$ if $P(1) = 0, P(2) = 0$

$\Rightarrow 4a_0 + 3a_1 = -2, 32a_0 + 12a_1 = -4$

Solving we get, $a_0 = \frac{1}{4}$, $a_1 = -1$

$\therefore P(x) = \frac{1}{4}x^4 - x^3 + x^2$

$\Rightarrow P(2) = \frac{1}{4}(16) - 8 + 4 = 0$

10.[A] Let A & B meet at R, speed of current be t km/h

& speed of A & B be $3k$ & k respectively.

Time taken by A to reach R from

$S = \frac{10}{(3k+t)}$

In this time cork will travel from S towards T a distance of $= \frac{10t}{(3k+t)}$

Distance remaining from $T = 8 - \frac{10t}{(3k+t)}$.

Time taken by cork to cover this distance & time taken by B to cover 2 km are same.

$\Rightarrow 8 - \frac{10t}{(3k+t)} = \frac{2}{(k-t)}$

Solving $k = \frac{4}{3}t$

Upstream speed of

$A = 3k - t = \left(3\times\frac{4}{3} - 1\right)t = 3t$

Downstream speed of $B = k + t = \frac{7}{3}t$

ratio $= \frac{3}{\left(\frac{7}{3}\right)} = \frac{9}{7}$

11.[B] Replace x by $(1-x)$

$\Rightarrow f(1-x)+2f(x)=(1-x)^2+2$

Manipulate the equations to eliminate $f(1-x)$,

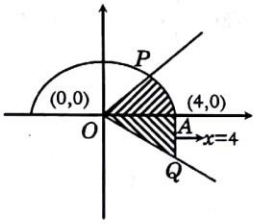
$$f(x)=\frac{(x-2)^2}{3}$$

12.[B] Required area is the area of shaded region ($APOQ$)

= area of ΔOAQ + area of sector (OAP)

$$=\frac{1}{2}\times 4\times 4\sqrt{3}+\frac{\pi(4\times 4)}{6}$$

$$=\left(\frac{8\pi}{3}+8\sqrt{3}\right)$$



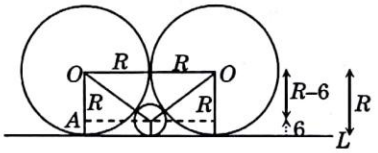
13.[A] $\frac{dv}{dt}=\lambda 4\pi r^2 \Rightarrow \frac{d\left(\frac{4}{3}\pi r^3\right)}{dt}=\lambda 4\pi r^2=\frac{dr}{dt}=\lambda$

$\Rightarrow r=\lambda t+c$ by using

$r_0=3$; $t=0$ and $r=2$ at

$t=1 \qquad r=3-t$

14.[C]



$OP=R+6$, $OA=R-6$ and $AP=R$

$OP^2=OA^2+AP^2$

$(R+6)^2=(R-6)^2+R^2$

$R^2+12R+36=R^2-12R+36+R^2$

$24R=R^2$

So, $R=24$ unit

15.[A] $\frac{x^2}{16}+\frac{y^2}{4}=1$

The tangent at $P(\theta)$is $\frac{x}{4}\cos\theta+\frac{y}{2}\sin\theta=1$

The focus of the parabola

$x^2=8(y-6)$, is $(0, 8)$.

$\therefore 0+\frac{8}{2}\sin\theta=1 \quad \Rightarrow \sin\theta=\frac{1}{4}$.

16.[C] Required number of subset of A

= total number of subsets –

(All subsets with even integers only

+ all subsets with odd integers only – 1)

$= 2^{10}-(2^5+2^5-1)=1024-(63)=961.$

17.[C] diff. on both the sides.

$f(x^2).\ 2x=6x+[-x^2\ .\ f(x^2).\ 2x]$

$f(x^2)[2x+2x^3]=6x$

$$f(x^2)=\frac{6x}{2x+2x^3}=\frac{3}{1+x^2}$$

at $x=2, f(4)=\frac{3}{1+4}=\frac{3}{5}$

18.[B] Let E_1 be the event that B rides A,

E_2 the event that C rides A and

E the event that A wins

$p(E_1)=\frac{2}{2+1}=\frac{2}{3}$, $p(E_2)=1-\frac{2}{3}=\frac{1}{3}$

also according to question,

$p\left(\frac{E}{E_1}\right)=\frac{1}{6}$ (since all horses are equally likely to win when B rides A)

and $p\left(\frac{E}{E_2}\right)=3\times\frac{1}{6}=\frac{1}{2}$

$$\therefore p(E)=p(E_1)p\left(\frac{E}{E_1}\right)+p(E_2)p\left(\frac{E}{E_2}\right)$$

$$=\frac{2}{3}\times\frac{1}{6}+\frac{1}{3}\times\frac{1}{2}=\frac{5}{18}.$$

19.[B] Let $f(x) = y$

$$\Rightarrow x = \frac{3 \pm \sqrt{9 - 4(1-y)}}{2}$$

$$\Rightarrow x = \frac{3 \pm \sqrt{5+4y}}{2}$$

$$\Rightarrow x = \frac{3 + \sqrt{5+4y}}{2} \ (\text{as } x > 2)$$

$$\Rightarrow g(x) = \frac{3+\sqrt{5+4x}}{2}$$

$$\Rightarrow g'(x) = \frac{1}{\sqrt{5+4x}}$$

$$\Rightarrow g'(1) = \frac{1}{3}$$

Alter : $f(g(x)) = x$

$$f'(g(x)).\, g'(x) = 1$$

$$\Rightarrow g'(x) = \frac{1}{f'(g(x))}$$

$$g'(1) = \frac{1}{f'(g(1))}$$

[where $f(x) = x^2 - 3x + 1 = 1$, $x = 0$, $x = 3$ but $x \geq 2$]

$$= \frac{1}{f'(3)}$$

$$g'(1) = \frac{1}{3} \quad \Rightarrow \quad \frac{1}{g'(1)} = 3$$

20.[B] $\lim\limits_{n\to\infty} n\left\{\sqrt[3]{n^3+3n^2+2n+1} - (n+1)\right\}$

$$+ n\left\{\sqrt{n^2-2n+3} - (n-1)\right\}$$

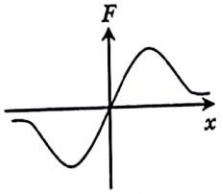
$$\lim_{n\to\infty} \frac{n\{(n^3+3n^2+2n+1)-(n+1)^3\}}{(n^3+3n^2+2n+1)^{2/3}+(n+1)(n^3+3n^2+2n+1)^{1/3}+(n+1)^2} + \frac{n\{n^2-2n+3-(n-1)^2\}}{\sqrt{n^2-2n+3}+(n-1)}$$

$$\lim_{n\to\infty} \frac{n(-n)}{(n^3+3n^2+2n+1)^{2/3}+(n+1)(n^3+3n^2+2n+1)^{1/3}+(n+1)^2} + \lim_{n\to\infty} \frac{n(2)}{\sqrt{n^2-2n+3}+(n-1)}$$

$$= \frac{-1}{1+1+1} + \frac{2}{1+1} = -\frac{1}{3} + 1 = \frac{2}{3}$$

PHYSICS

21.[C]



22.[D] $\vec{v} \times \vec{B} = -\vec{E}$

$$(\hat{i} + \hat{j}) \times (2\hat{i} + 3\hat{k}) = -\vec{E}$$

$$(-3\hat{i} + 3\hat{j} + 2\hat{k}) = \vec{E}$$

23.[D] $\vec{F} = I\vec{\ell} \times \vec{B}$

$\vec{\ell} = \overrightarrow{AD} = R(\hat{i} - \hat{j})$

$\vec{B} = B_0(\hat{i} + \hat{j} - \hat{k})$

$$\therefore \quad \vec{F} = IRB_0 \times (\hat{i} - \hat{j}) \times (\hat{i} + \hat{j} - \hat{k})$$

$$= IRB_0 \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 0 \\ 1 & 1 & -1 \end{vmatrix}$$

$$= IRB_0 \times (\hat{i} + \hat{j} + 2\hat{k})$$

$$F = IRB_0\sqrt{6}$$

Alter :

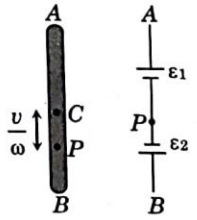
$\vec{B} = B_0(i + \hat{j} - \hat{k})$

$\vec{\ell} = R(\hat{i} - \hat{j})$

$\vec{B}\vec{\ell} = 0 \Rightarrow$ Angle $= 90° \Rightarrow F = BI\ell$

$= \sqrt{3}B_0 I\sqrt{2}R = \sqrt{6}B_0 IR$

24.[A] Point P is at instantaneous rest,



$$\varepsilon_1 = |V_P - V_A| = \frac{1}{2}B\omega\left(\frac{\ell}{2} + \frac{\upsilon}{\omega}\right)^2$$

$$\varepsilon_1 = |V_P - V_B| = \frac{1}{2}B\omega\left(\frac{\ell}{2} + \frac{\upsilon}{\omega}\right)^2$$

$|V_A - V_B| = \varepsilon_1 - \varepsilon_2$

$|V_A - V_B| = B\ell v$

25.[A] The work done by cell = $\int Vdq$

$$= \int_0^V CVdV = \frac{1}{2}CV^2$$

26.[A] The potential difference across completely charged capacitor is V. As the switch is pushed to b, the initial current in the resistor R is $\frac{V}{R}$.

27.[A] The number of minima on screen shall remain same on tilting the beam by some angle (90°).

28.[C] $v_i = v_0$ and $v_f = \sqrt{v_0^2 + \left(\frac{qE}{m}t\right)^2}$

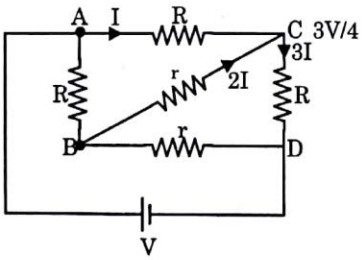
and $v_f = 2v_i \Rightarrow t = \sqrt{3}\,\frac{m_0 v_0}{q_0 E_0}$

29.[C] As the accelerating potential difference is changed only the minimum wavelength changes. It has no effect on wavelengths of characteristic x-rays (whether they are produced or not)

∴ (C) is the correct choice.

30.[A] $I_{AC} = \frac{V}{4R} = I$

$I_{CD} = \frac{3V}{4R} = 3\,I_{AC} = 3I$



Hence using KCL at junction C

$I_{BC} = 3I - I = 2I = \frac{V}{2R}$

31.[A] From Newton's equation of lens

Size of object = $O^2 = I_1 I_2$

Where I_1 is size of image of object and I_2 is size of image when position of object & image are interchanged

So $A^2 = A_1 A_2$

$\Rightarrow A = \sqrt{A_1 A_2}$

32.[C] $X_L = X_C$ at resonance

$\therefore \frac{X_L}{X_C} = 1$. for both circuit

33.[C] γ, α, β

34.[A] If heat is supplied at constant rate P, then $Q = P\Delta t$ and as during change of state $Q = mL$, so, $mL = P\Delta t$

i.e., $L = \left[\frac{P}{m}\right]\Delta t = \frac{P}{m}$ (length of line AB)

Hence $L_1 > L_2$

i.e., the ratio of latent heat of fusion of the two substances are in the ratio 3 : 4.

In the portion OA the substance is in solid state and its temperature is changing

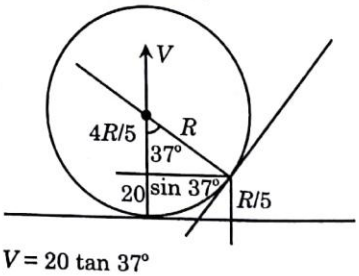
$\Delta Q = mC\Delta T$ and $\Delta Q = P\Delta t$

So, $\frac{\Delta T}{\Delta t} = \frac{P}{mC}$ or

$\text{slope} = \frac{P}{mS} = \left[\text{as } \frac{\Delta T}{\Delta t} = \text{slope}\right]$

Hence $C_1 < C_2$

35.[B] 20 sin 37° = V cos 37°

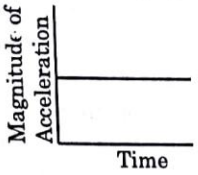


$V = 20 \tan 37°$

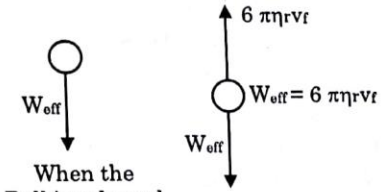
$V = 20 \times \frac{3}{4}$

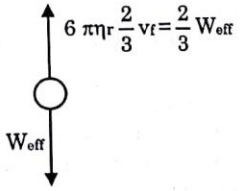
$V = 15$ m/s

36.[C] Since angular velocity is constant, acceleration of centre of mass of disc is zero. Hence the magnitude of acceleration of point S is $\omega^2 x$ where ω is angular speed of disc and x is the distance of S from centre. Therefore the graph is



37.[A]





When the ball is just released, the net force on ball is W_{eff} ($= mg$ – buoyant force).

The terminal velocity 'v_f' of the ball is attained when net force on the ball is zero

$\therefore$ Viscous force $6\pi\eta r v_f = W_{eff}$

When the ball acquired $\frac{2}{3}$ rd of its maximum velocity v_f the viscous force is

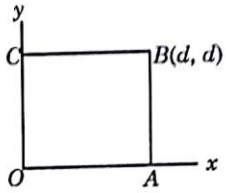
$= \frac{2}{3} W_{eff}$

Hence net force is $W_{eff} - \frac{2}{3} W_{eff} = \frac{1}{3} W_{eff}$

$\therefore$ required acceleration is $= \frac{a}{3}$

38.[D] $W = \int \vec{F}.d\vec{x} = \int A(y^2\hat{i} + 2x^2\hat{j}).(dx\hat{i} + dy.\hat{j})$

$= A\int (y^2 dx + 2x^2 dy)$



$W_{OA} = 0 + 0$, $W_{AB} = A[0 + 2d^2\, d]$

$W_{BC} = A[d^2\,(-d) + 0]$, $W_{CD} = A[0 + 0]$

$W = 0 + 2Ad^3 - Ad^3 + 0 = Ad^3$

39.[A] 296 Hz

40.[C] $PV = nRT$

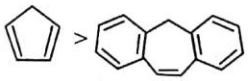
$PdV = nRdT$

$\gamma = \frac{1}{V}\frac{dV}{dT}$ and $\frac{dV}{dT} = \frac{nR}{P}$ $\gamma = \frac{1}{T}$

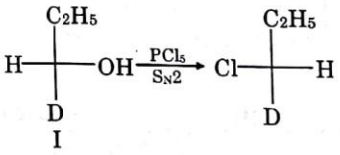
For given temperature T_0, $\gamma = \frac{1}{T_0}$

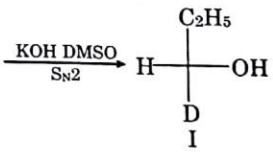
CHEMISTRY

41.[A]



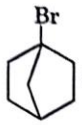
42.[B]





43.[B] Zn-Hg/conc. HCl affect carbon-carbon double bond as well as OH group. The Pd/H_2 reduction affect the carbon double bond and convert carbonyl group to alcohol.

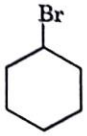
44.[A] CH_3–Br; CH_3–CH_2–Cl; OHC–CH_2–Br;



; CH_2=CH–Br

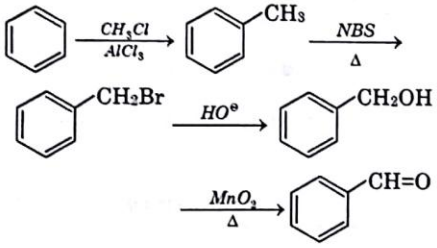
These are not reactive for S_N1 reaction

45.[A]

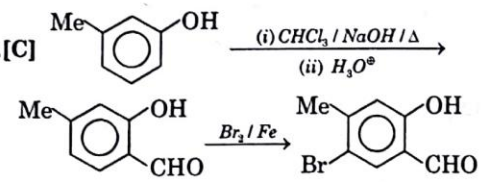


Give same product from SN^1 & SN^2 reaction because in this no stereochemistry involve and it do not undergo rearrangement. In both these case SN^1 & SN^2 give same product.

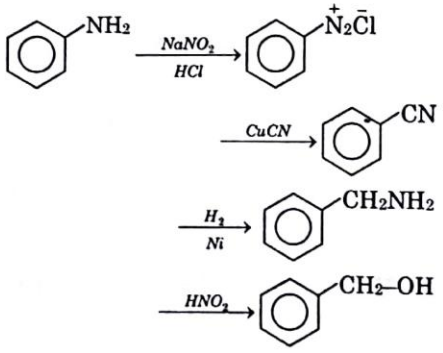
46.[B]



47.[C]



48.[A]



49.[A] Froth floatation process is used in metallurgy of sulphide ore.
Pine oil is used to remove impurities like dust.
Removal of impurity is called concentration process.
In Froth floatation concentration is based on adsorption of impurity on froth.

50.[A] $r_1 = K_1C_1$ and $r_2 = K_2C_2$
Since rate of first order reaction is directly proportional to the concentration of its reactant, $r \propto$ Conc.

$$\therefore \quad \frac{r_1}{r_2} = \frac{C_1}{C_2} = \frac{3\times10^{-4}}{2\times10^{-4}}$$

According to first order reaction

$$K = \frac{2.303}{t_{75} - t_{25}} \log \frac{C_1}{C_2}$$

On substituting the various values

$K = 0.008290\ \text{min}^{-1}$

$$t_{1/2} = \frac{0.693}{K} = \frac{0.693}{0.008290} = 83.33\ \text{min}$$

51.[D] $4HNO_3 + P_4O_{10} \xrightarrow{\text{heat}} 2N_2O_5 + 4HPO_3$

52.[B] In adsorption there is bond formation between the gases and solid surface which decreases the entropy. But adsorption is spontaneous. Hence, the enthalpy change must be negative

53.[D] Equivalent of $C_2O_4^{2-}$ = equivalents of $K_2Cr_2O_7$

$$M \times 2 \times 25 = \frac{1}{10} \times 10$$

$$M = \frac{1}{50}$$

54.[B] $P_{N_2} = K_H \times$ solubility

$$1 \times 76.48 \times 10^3 \times \frac{n_{N_2}}{\frac{10000}{18}}$$

$n_{N_2} = 7.16$ millimoles

55.[A] (a) (F) ; As the size of halogen atom increases crowding on Si atom will increase, hence, tendency of attack of Lewise base decreases.
(b) (T) ; M.P. of $NH_3$is highest due to intermolecular H-bonding in it.
Next lower M.P. will be of SbH_3 followed by AsH_3 due to high mol. wt. of SbH_3.
(c) (F); M.P. and B.P. of increase from PH_3 to SbH_3 via AsH_3 due to increase in mol. wt. NH_3 does not follow this trend due to inter molecular H-bonding.
Increasing B.P. order :
$PH_3 < AsH_3 < NH_3 < SbH_3$
(d) (T); Value of bond moment decreases.

56.[A] $2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$;
$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

57.[C] $2NO_2^- + 3I^- + 4CH_3COOH$
$\longrightarrow I_3^- + 2NO\uparrow + 4CH_3COO^- + 2H_2O$
I_3^- + starch $\longrightarrow$ Blue colouration

58.[D] In addition to 4f electron, the 5f electrons themselves provide poor shielding from element to element in the series so, actinoid contraction is greater than lanthanoid contraction.

59.[D] The cyano and ammine complexes are far more stable than those formed by halide ions. This is due to the fact that NH_3 and CN^- are strong lewis bases.

60.[C] For ideal and non-ideal solutions
$\Delta G_{mix} = -ve$

BIOLOGY

61.[C] Gibberellin

62.[A] Xylem parenchyma

63.[C] Copper

64.[B] Mitochondria

65.[C] Vernalization & photoperiodism

66.[D] 3.4 μm

67.[C] degradation of glucose

68.[A] biomass

69.[C] Chemical signals between ants

70.[D] High CO_2

71.[B] i - d, ii - b, iii - a, iv – c

72.[B] During growth, the LAB produce acids that coagulate and partially digest the milk proteins

73.[C] Miller created electric discharge in a closed flask containing CH_4, H_2, NH_3 & water vapour at 400°C

74.[C] a, b, c, d

75.[B] Constipation, abdominal pain, cramps, blood clots

76.[A] Latex of Papaver somniferum

77.[C] It is the transparency of piezo electric material which is a critical factor in allowing proper vibrational frequency

78.[D] (iii), (C)(R)

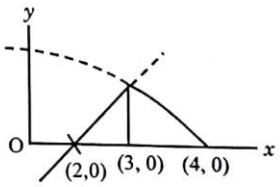
79.[A] 100 sperms and 100 ova

80.[A] corona radiata, zone pellucida, vitelline membrane

PART-II [Two Marks Questions]

MATHEMATICS

81.[A] Area $= \frac{1}{2} + \int_3^4 \sqrt{4-x}\,dx$



$= \frac{1}{2} + \left(-\frac{(4-x)^{3/2}}{-\frac{3}{2}} \right)_3^4 = \frac{1}{2} - \frac{2}{3}(0-1) = \frac{7}{6}$

82.[A] $g[f(x)] = f[g(x)] = \begin{bmatrix} x^2 & if\ x \geq 0 \\ 0 & if\ x < 0 \end{bmatrix}$

83.[D] $f(x) = 4x - x^2$

$f'(x) = 4 - 2x$

$\therefore$ $f'(x) > 0$ if $x < 2$

and $f'(x) < 0$ if $x > 2$

$\therefore$ If $x < 2$, then $f(x)$ is increasing

If $x > 2$, then $f(x)$ is decreasing

$f(2) = 4$

(i) If $P = (-\infty, 2]$, then $f(x)$ one-one and range $= (-\infty, 4]$

$\therefore$ $f(x)$ is onto if $Q = (-\infty, 4]$

(ii) If $P = [2, \infty)$ then $f(x)$ is one-one and range $= (-\infty, 4]$

$\therefore$ $f(x)$ is onto if $Q = (-\infty, 4]$

84.[B] $x^4 + 4 = x^4 + 4 + 4x^2 - 4x^2$

$= (x^2 + 2)^2 - (2x)^2$

$= (x^2 + 2x + 2)(x^2 - 2x + 2)$

$$\therefore I = \int (x^2 + 2x + 2)dx = \frac{x^3}{3} + x^2 + 2x + C$$

85.[C] Let $f(\alpha) = \left(1 + \frac{1}{\sin^n \alpha}\right)\left(1 + \frac{1}{\cos^n \alpha}\right)$

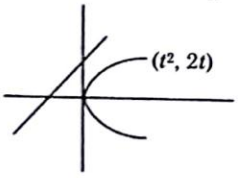
$$= 1 + \frac{1}{\sin^n \alpha} + \frac{1}{\cos^n \alpha} + \frac{1}{\sin^n \alpha \cos^n \alpha}$$

Now, $f'(\alpha) = 0 \Rightarrow \cos \alpha = \sin \alpha \Rightarrow \alpha = \frac{\pi}{4}$

Hence $f(\alpha)$ is maximum at $\alpha = 0$ and $\alpha = \frac{\pi}{2}$ & between two maxima, there is one minima.

Hence $\alpha = \frac{\pi}{4}$ given the minimum value of $f(\alpha)$ and is given by $f(\pi/4) = (1 + 2^{n/2})^2$]

86.[C] $\frac{x - t^2}{1} = \frac{y - 2t}{-1} = -2\frac{(t^2 - 2t + 2)}{2}$



$\Rightarrow$ $x = 2t - 2$ $\Rightarrow$ $t = \frac{x + 2}{2}$

and $y = t^2 + 2$ $\Rightarrow$ $y - 2 = \frac{(x + 2)^2}{4}$

$\Rightarrow$ $4(y - 2) = (x + 2)^2$

87.[C] ways $= {}^{m+n-1}C_{n-1} - {}^nC_m$

88.[B] $E = (x - \alpha_1)(x - \alpha_2)(x - \alpha_3) \ldots\ldots (x - \alpha_n)$

Where $\alpha_1 = 1$, $\alpha_2 = 2$ etc

$= x^n - (\sum \alpha_1) x^{n-1} + (\sum \alpha_1 \alpha_2) x^{n-2} \ldots\ldots$

Hence co-efficient of x^{n-2} = sum of the product of the first 'n' natural numbers taken two at a time.

Now consider

$$= \frac{(1 + 2 + 3 \ldots\ldots + n)^2 - (1^2 + 2^2 + 3^2 \ldots\ldots + n^2)}{2}$$

89.[B] $y^2 = x^2 (x + 1)$ $x + 1 \geq 0$

$y = \pm x\sqrt{x + 1}$

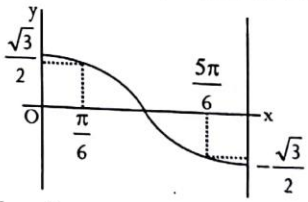
$$\therefore \frac{dy}{dt} = \pm\left(\sqrt{x + 1} + \frac{x}{2\sqrt{x + 1}}\right)$$

$$= \pm \frac{2(x + 1) + x}{2\sqrt{x + 1}} = \pm \frac{3x + 2}{2\sqrt{x + 1}}$$

$$\therefore \left.\frac{dy}{dx}\right|_{x=0} = \pm 1$$

$\therefore$ at (0, 0) the curve bisects the angle between the axes.

90.[D] $|\cos 3x| + |\cos x| = |\cos 3x + \cos x|$



iff $\cos 3x \,.\, \cos x \geq 0$

iff $(4\cos^3 x - 3 \cos x) \cos x \geq 0$

iff $\cos^2 x\,(4 \cos^2 x - 3) \geq 0$

iff $\cos x = 0$ or $\cos^2 x \geq \frac{3}{4}$

iff $x = \frac{\pi}{2}$ or $|\cos x| \geq \frac{\sqrt{3}}{2}$

$$x = \frac{\pi}{2} \text{ or } x \in \left[0, \frac{\pi}{6}\right] \cup \left[\frac{5\pi}{6}, \pi\right]$$

PHYSICS

91.[A] The force of attraction between the complete sphere and mass m is

$$F = \frac{GmM}{(2R)^2} = \frac{GmM}{4R^2} \quad \text{.....(i)}$$

Mass of complete sphere is $M = \frac{4\pi}{3}R^3\rho$

Mass of the cut out portion is

$$m_0 = \frac{4\pi}{3}\left(\frac{R}{2}\right)^3 \rho .$$

Thus, $m_0 = \frac{M}{8}$.

The distance between the centre of the cutout portion and mass

$$m = 2R - \frac{R}{2} = \frac{3R}{2}$$

Hence the force of attraction between the cut out portion and mass m is

$$f = \frac{Gm_0m}{(3R/2)^2} = \frac{G(M/8)m}{9R^2/4} = \frac{GmM}{4R^2} \times \frac{2}{9}$$

Using (i), we get $f = \frac{2F}{9}$.

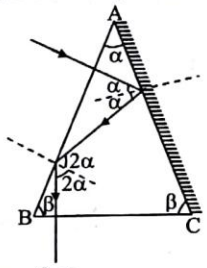
Therefore, the force of attraction between the remaining part of the sphere and mass

$$M = F - f = F - \frac{2F}{9} = \frac{7F}{9}$$

Which is choice (A)

92.[B] Induced current decreases with time linearly in this case

93.[B] The path of the ray is shown



It is clear that

$\alpha + 2\beta = 180°$

and $\beta = 2\alpha$

Hence, $\alpha = 36°$, which is choice (B).

94.[B] The angular momentum L will be conserved

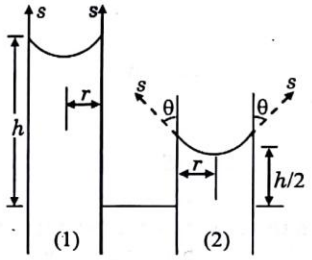
Initial rotational KE = $E_i = \frac{L^2}{2I_1}$

Final rotational KE = $E_f = \frac{L^2}{2I_2}$

Work done = $E_f - E_i = \frac{L^2}{2}\left[\frac{1}{I_2} - \frac{1}{I_1}\right]$

95.[D] In (1) $2\pi rs = \pi r^2 h\rho g$

In (2) $2\pi rs\cos\theta = \pi r^2\left(\frac{h}{2}\right)\rho g$

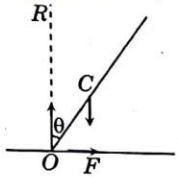


Dividing, $\cos\theta = \frac{1}{2}$

or $\theta = 60°$

96.[C] C = centre of mass

Taking torques about C,

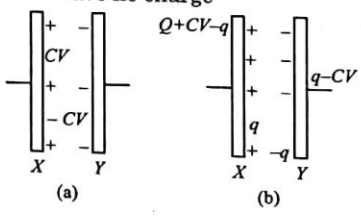


$F \times OC\cos\theta = N \times OC\sin\theta$

or $F = mg\tan\theta = ma$

or $a = g\tan\theta$

97.[C] In figure, let X and Y be positive and negative plates. After charging from the cell, the inner faces of X and Y have charges $\pm CV$, as shown in (a). The outer surfaces have no charge



When charge Q is give to X, let the inner faces of X and Y have charges $\pm q$. Then, by the principle of charge conservation, the outer faces have charges $(Q + CV - q)$ for X and $(q - CV)$ for Y, as shown in (b). Now, the outer faces must have equal charges.

$\therefore \quad Q + CV - q = q - CV$

or $\quad 2q = 2CV + Q$

or $\quad q = CV + \frac{Q}{2}$

Potential difference $= \frac{q}{C} = V + \frac{Q}{2C}$

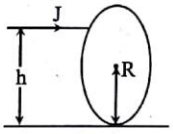
98.[B] In the steady state, the current in the coil is $I = E/R$.

The energy stored in it is

$$E = \frac{1}{2}LI^2 = \frac{LE^2}{2R^2}$$

When the switch is opened, this energy is shared equally between the two resistances.

99.[C] Let J be the impulse, m the mass of the sphere, v the linear velocity and ω the angular velocity just after the impact.



$J = mv$ and $v = R\omega$ for pure rolling

$$J(h - R) = I\omega = \left(\frac{2}{5}mR^2\right)\frac{v}{R} = \frac{2}{5}mvR$$

$$= \frac{2}{5}JR$$

or $\quad 5(h - 2R) = 2R$

or $\quad 5h = 7R$

or $\quad h = \frac{7}{5}R$

100.[C] The momentum of the two particle system at $t = 0$ is given by

$\vec{p}_i = m_1\vec{v}_1 + m_2\vec{v}_2$

A collision between the two does not affect the total momentum of the system

A constant external force $(m_1 + m_2)g$ acts on the system.

The impulse given by this force in time $t = 0$ to $t = 2t_0$ is $(m_1 + m_2)g \times 2t_0$.

$\therefore$ The absolute change in momentum in this interval is

$$|(m_1\vec{v}_1' + m_2\vec{v}_2') - (m_1\vec{v}_1 + m_2\vec{v}_2)|$$

$$= 2(m_1 + m_2)gt_0$$

CHEMISTRY

101.[C] $2\left[24 = \frac{1}{3}p_A^0 + \frac{2}{3}p_B^0 \ldots\ldots\ldots\ldots(1)\right]$

$$24 \times \left(1\frac{1}{4}\right) = \frac{2}{3}p_A^0 + \frac{1}{3}p_B^0 \ldots\ldots\ldots(2)$$

Subtracting we get

$p_B^0 = 18$ torr

Hence $p_A^0 = 36$ torr

102.[A] 'A' is correct on the basis of structure of B_2H_6

103.[C] Both are correct diagram.

104.[C] At half-way between two colours

$[H\,In] = [In^-]$

Now $\quad pK_{In} = pH + \log\frac{[H\,In]}{[In^-]} = pH$

Now $\quad$ pH of buffer = 5.45 when

$$5.45 = 4.75 + \log\frac{[salt]}{[acid]}$$

So $\quad \log\frac{[salt]}{[acid]} = 0.70$

$$\frac{[salt]}{[acid]} = 5:1$$

105.[B] 20 mole C_6H_6, 10 mole C_6H_5Cl

$\Rightarrow X_B = \frac{2}{3}, X_C = \frac{1}{3}$

At $t = 100°C$

$$\Rightarrow p_s = 300 \times \frac{1}{3} + 1350 \times \frac{2}{3}$$

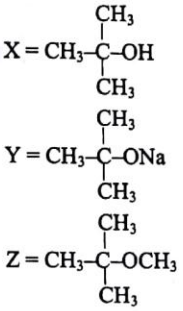
$$= 100 + 900 \ (=1000$$

106.[B] NaCl left = $10^{-3} - 5 \times 10^{-4} = 5 \times 10^{-4}$ mol

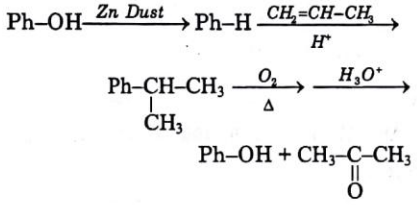
No. of unit cell = $\frac{5}{4} \times 10^{-4} \times 6 \times 10^{23}$

$= 7.5 \times 10^{19}$

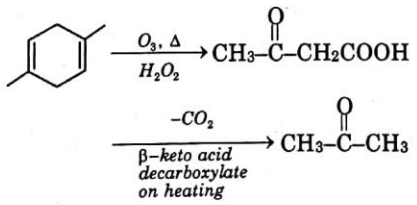
107.[C]



108.[B]



109.[C]



110.[B] Factual

BIOLOGY

111.[C] Blood transfusion

112.[B] Polio is not a viral disease

113.[C] Malaria is caused by plasmodium

114.[B] Cells are basic unit

115.[D] Depends on condition

116.[A] Her mother and maternal grand father were colour blind

117.[C] AB and O

118.[A] Autosomal genes

119.[B] Klinefelter's syndrome

120.[C] Sex-linked disease

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-10

Stream – SX

Hints & Solutions

Answer key

1.(C)	2.(C)	3.(C)	4.(D)	5.(D)	6.(A)	7.(A)	8.(B)	9.(B)	10.(A)	11.(A)	12.(A)	13.(A)	14.(D)
15.(C)	16.(A)	17.(A)	18.(C)	19.(A)	20.(A)	21.(C)	22.(B)	23.(C)	24.(A)	25.(C)	26.(B)	27.(B)	28.(D)
29.(A)	30.(C)	31.(B)	32.(D)	33.(B)	34.(A)	35.(A)	36.(C)	37.(A)	38.(B)	39.(A)	40.(B)	41.(C)	42.(C)
43.(D)	44.(A)	45.(A)	46.(C)	47.(C)	48.(C)	49.(A)	50.(A)	51.(B)	52.(A)	53.(A)	54.(B)	55.(B)	56.(C)
57.(A)	58.(B)	59.(C)	60.(A)	61.(C)	62.(D)	63.(B)	64.(B)	65.(C)	66.(C)	67.(C)	68.(B)	69.(C)	70.(D)
71.(D)	72.(D)	73.(C)	74.(C)	75.(A)	76.(A)	77.(C)	78.(B)	79.(C)	80.(A)	81.(A)	82.(C)	83.(A)	84.(C)
85.(B)	86.(A)	87.(C)	88.(D)	89.(A)	90.(B)	91.(D)	92.(A)	93.(C)	94.(A)	95.(D)	96.(C)	97.(B)	98.(D)
99.(A)	100.(B)	101.(A)	102.(C)	103.(B)	104.(A)	105.(B)	106.(A)	107.(D)	108.(D)	109.(D)	110.(B)	111.(D)	112.(A)
113.(C)	114.(C)	115.(B)	116.(B)	117.(C)	118.(B)	119.(B)	120.(C)						

PART-I [One Mark Questions]

MATHEMATICS

1.[C] 9

2.[C] $x = -5 + 4\iota$

$\Rightarrow (x+5)^2 = -16$

$\Rightarrow x^2 + 10x + 41 = 0$

$x^4 + 9x^3 + 35x^2 - x + 4$

$= (x^2 + 10x + 41)(x^2 - x + 4) - 160$

Since $x^2 + 10x + 41 = 0$

$\therefore \; x^4 + 9x^3 + 35x^2 - x + 4 = -160$

3.[C] 1024

4.[D] $n\pi + (-1)^n \frac{\pi}{3}, n \in I$

5.[D] $z^3 + \frac{3(\bar{z})^2}{|z|} = 0$ Let $z = re^{\iota\theta}$

$\Rightarrow r^3 e^{\iota 3\theta} + 3re^{-\iota 2\theta} = 0$

Since 'r' cannot be zero

$\Rightarrow re^{\iota 5\theta} = -3$ which will hold for $r = 3$ and 5 distinct values of 'θ'

Thus there are five solution

6.[A] $I = \int_{-100}^{100} f(x)dx = 200\int_0^1 f(x)dx$

($\because$ 1 is period of $f(x)$)

$$f(x) = \begin{cases} \{x\} & 0 \le x < \frac{1}{2} \\ \{-x\} & \frac{1}{2} \le x \le 1 \end{cases}$$

$$= \begin{cases} x & ; \; 0 \le x < \frac{1}{2} \\ 1-x & ; \; \frac{1}{2} \le x \le 1 \end{cases}$$

$$I = 200\left(\int_0^{1/2} x dx + \int_{1/2}^1 (1-x)dx\right)$$

$$= 200\left(\frac{1}{8} + \left(1 - \frac{1}{2}\right) - \frac{1}{2}\left(1 - \frac{1}{4}\right)\right)$$

$$= 200\left(\frac{1}{8} + \frac{1}{8}\right) = 50$$

7.[A] $c_1 \to c_1 - c_2$ and $c_2 \to c_2 - c_3$
$\Rightarrow$ two identical columns
$\Rightarrow$ A

8.[B] $y.e^{\int \sec^2 x dx} = \int e^{\tan x}.\tan x.\sec^2 x dx + c$
$y.e^{\tan x} = e^{\tan x}(\tan x - 1) + c$
$y = (\tan x - 1) + c.e^{-\tan x}$

9.[B] $a = 4, e = \frac{5}{4}$
$\therefore$ foci are $(\pm 5, 0)$
Equation of the conjugate hyperbola is
$16y^2 - 9x^2 = 144$
Its foci are $(0, \pm 5)$
$\therefore$ area of the rhombus = 50

10.[A] $\tan(\cos^{-1} x) = \sin\left(\cos^{-1}\frac{1}{2}\right)$

$\cot^{-1}\frac{1}{2} = t \qquad t \in \left(0, \frac{\pi}{2}\right)$

$\cot t = \frac{1}{2}$

$\sin t = \frac{2}{\sqrt{5}}$

$\tan(\cos^{-1} x)$
$\cos^{-1} x = t \in [0, \pi]$
$\cos t = x$

$\tan t = \sqrt{1-x^2} \quad t \in \left[0, \frac{\pi}{2}\right]$

$\sqrt{1-x^2} = \frac{2}{\sqrt{5}}$

$1 - x^2 = \frac{4}{5}$

$\Rightarrow x^2 = \frac{1}{\sqrt{5}}$

$x = \pm\frac{1}{\sqrt{5}}$

$x = \frac{1}{\sqrt{5}}$ only one solution

11.[A] $\lim_{x\to 0} \frac{x}{a}\left[\frac{b}{x}\right] = \lim_{x\to 0} \frac{x}{a}\left(\frac{b}{x} - \left\{\frac{b}{x}\right\}\right)$

$= \frac{b}{a}\lim_{x\to 0} \frac{x}{a}\left\{\frac{b}{x}\right\}$

$= \frac{b}{a}$ ($\because \lim_{x\to 0}\left\{\frac{b}{x}\right\}$ is a finite number)

12.[A] Let $\det(-2A) = (-2)^3 \Delta = -8\Delta$

13.[A] $r(t) = 3 - t$

14.[D] Image of the interval $[-1, 3]$ under the mapping
$f(x) \Rightarrow [f(x)]_{max}, f(x)]_{min}]$ in $[-1, 3]$
$f'(x) = 0 \Rightarrow x = \pm 1$; $f(-1)$; $f(1)$ & $f(3)$
and interpret the result

15.[C] $1 = \frac{1}{2}\begin{vmatrix} x & y & 1 \\ 1 & 1 & 1 \\ 2 & 0 & 1 \end{vmatrix} \Rightarrow x + y = 4$

$\therefore$ number of solutions = 3

$\therefore$ the required probability = $\frac{3}{36} = \frac{1}{12}$

16.[A] $3 < p < 4$
$\Rightarrow p^2 - 7p + 12 < 0$ and
$q > 4$ or $q < 3 \Rightarrow q^2 - 7q + 12 > 0$
$\therefore p^2(7q - 12) < q^2(7p - 12)$

17.[A] For a given perimeter an equilateral triangle has the maximum area

$\Rightarrow A_{max} = \frac{\sqrt{3}}{4}\left(\frac{2s}{3}\right)^2 = \frac{s^2}{3\sqrt{3}}$

$\Rightarrow A \le A_{max}$

$\Rightarrow A \le \frac{s^2}{3\sqrt{3}}$

18.[C] $x + 2y = 9$, $3x - 5y = 5$, $ax + by = 1$
are concurrent

$\begin{vmatrix} 1 & 2 & -9 \\ 3 & -5 & -5 \\ a & b & -1 \end{vmatrix} = 0$

$\Rightarrow 1(5 + 5b) + 2(-5a + 3) - 9(3b + 5a) = 0$
$\Rightarrow -55a - 22b + 11 = 0$
$\Rightarrow 5a + 2b = 1$
Hence line $5x + 2y = 1$ passes through the point (a, b)

19.[A] The given condition can be written
$(\cos^2\alpha + \sin^2\alpha)^3 - 3\sin^2\alpha\cos^2\alpha$
$(\cos^2\alpha + \sin^2\alpha) + k\sin^2 2\alpha = 1$
$\Rightarrow (-3/4)\sin^2 2\alpha + k\sin^2 2\alpha = 0$
Showing that $k = 3/4$

20.[A] Let $\vec{c} = \lambda(\vec{a} \times \vec{b})$.

Hence $\lambda(\vec{a} \times \vec{b}).(\hat{i} + 2\hat{j} - 7\hat{k}) = 10$

But $\vec{a} \times \vec{b} = (-7\hat{i} - 5\hat{j} - \hat{k})$,

let $\vec{c} = (7\hat{i} + 5\hat{j} + \hat{k})$

$\Rightarrow \vec{c} = -(\vec{a} \times \vec{b})$

PHYSICS

21.[C] The exponent is dimensionless. Hence

$$[a] = \left[\frac{k\theta}{x}\right] = \left[\frac{JK^{-1} \times K}{m}\right]$$

$$= J\, m^{-1}$$

$$= [ML^2T^{-2}] \times [L^{-1}]$$

$$= MLT^{-2}$$

Also $[P] = \frac{[a]}{[b]}$

$$[b] = \frac{[a]}{[P]} = \left[\frac{ML^1T^{-2}}{ML^{-1}T^{-2}}\right]$$

$$= [M^0L^2T^0]\frac{a}{b}e^{-ax/k\theta}$$

So, the correct choice is (C).

22.[B] The range of a projectile is $2v_0^2 \cos\theta \sin\theta/g$, the two possible angles of projection are θ and $(90° - \theta)$.

The time of flight corresponding to these two angles are

$$t_1 = \frac{2v_0 \sin\theta}{g}$$

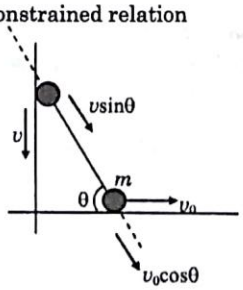
and $t_2 = \frac{2v_0 \sin(90° - \theta)}{g} = \frac{2v_0 \cos\theta}{g}$

so that $t_1t_2 = \frac{4v_0^2 \sin\theta\cos\theta}{g^2} = \frac{2r}{g}$.

Thus $t_1t_2 \propto r$.

Hence the correct choice is (b).

23.[C] By constrained relation



$$v\sin\theta = v_0\cos\theta$$

$$\Rightarrow v = v_0\cot\theta$$

$$= v_0 \cot 53° = \frac{3}{4}v_0$$

$$\therefore K.E. = \frac{1}{2}m\left(\frac{3v_0}{4}\right)^2 + \frac{1}{2}mv_0^2$$

$$= \frac{25}{32}mv_0^2$$

24.[A] The correct choice is (A).

25.[C] The correct choice is (C).

26.[B] Statement (A) is incorrect and statement (B) is correct. The reason is that electrons suffer a large number of collisions with the positive ions of the conductor. Although the electric field accelerates and electron between two collisions, it decelerates on collision. So the gain in speed between collisions is lost in the next collision. Thus the net acceleration averages out to zero and the electron acquires a constant average drift speed of the order of a few mms^{-1}.

Statement (C) is incorrect. The reason is that in addition to drift speed, electrons have random thermal speed which, for metals at room temperature, is about 10^7 times higher than average drift speed. Hence all free electrons do not necessarily move in the same direction.

Statement (D) is also incorrect. The current in a metal depends not only on charge (e) and drift speed (v_d), but also on the number density (n) of free electrons. Although e and v_d are small, we can still obtain a large current because n is very large ($\sim 10^{29}\ m^{-3}$).

27.[B] The intensity of magnetization (M) increases gradually as the magnetizing field H is increased. As H is increased further, M saturates when all the atomic magnetic dipoles have aligned themselves with the field H.

Hence the correct choice (B).

28.[D] Neutrons are neutral.

29.[A] The correct choice is (A).
The magnifying power is given by

$$M = \frac{L}{f_0}.\frac{D}{f_e} \text{ (for } D >> f_0\text{)}$$

Where L = distance between the objective and the eyepiece, D = least distance of distinct vision, f_0 = focal length of the objective and f_e =focal length of the eyepiece.

30.[C] is correct as $\mu_B > \mu_G$

31.[B] $\lambda = \frac{h}{p} = \frac{h}{mv}$.
Hence statement (B) is not true.

32.[D] Correct option is (D). Cadmium rods control the rate of fission by absorbing many neutrons and thus regulate the power level of the reactor.

33.[B] In transition ${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y$, the atomic (or charge) number increases by unity; mass number remaining the same. Hence an electron
(β-particle) is emitted. In transition ${}^{A}_{Z+1}Y \rightarrow {}^{A-4}_{Z-1}K$, the mass number decreases by 4 and charge number decreases by 2. Hence an α-particle is emitted. In the third transition, mass and charge numbers do not change. Hence a γ-ray is emitted. Hence the correct choice is (B).

34.[A] Correct option is (A)

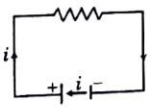
35.[A] The force on the electron is $e\sigma/\varepsilon_0$ and its acceleration towards the metal sheet is $e\sigma/m\varepsilon_0$.
The electron will move as a projectile with an effective value of $g = e\sigma/m\varepsilon_0$
Its maximum range will then be

$$\frac{u^2}{e\sigma/m\varepsilon_0} = \frac{u^2 m\varepsilon_0}{e\sigma}$$

36.[C] Initial flux linked with outer coil = $\phi = Mi$
when current is switched off, $\Delta\phi = Mi$

$$Q = \frac{\Delta\phi}{R} = \frac{Mi}{R}$$

37.[A]



38.[B] The correct option is (B). $v = \sqrt{\frac{\gamma P}{\rho}}$

39.[A] Tension must be the same in both the rods for their
junction to be in equilibrium.
$Y_1 A\alpha_1 t = Y_2 A\alpha_2 t$.

40.[B] The work done by unit mass of water during
expansion to form steam at constant pressure p_0 is

$$W = p_0\Delta V = p_0(V_{steam} - V_{water})$$

$$= p_0\left(\frac{1}{\rho_2} - \frac{1}{\rho_1}\right)$$

$$\Delta U = Q - W = Q - p_0\left(\frac{1}{\rho_2} - \frac{1}{\rho_1}\right)$$

CHEMISTRY

41.[C] *F, T*

42.[C] $PbS + O_2 \longrightarrow PbO + SO_2$
$PbS + 2O_2 \longrightarrow PbSO_4$

43.[D] ppt of copper thiosulphate dissolves in excess of hypo because of this complex formation

44.[A] The gas evolved will be H_2S

45.[A] We have,

$$\frac{[B]_t}{[C]_t} = \frac{4k_1}{3k_2} = \frac{16}{9}$$

So, $\frac{k_1}{k_2} = \frac{4}{3}$

Now, $k = k_1 + k_2$

$$= [2 \times 10^{-3} + \frac{3}{4} \times 2 \times 10^{-3}] \text{ sec}^{-1}$$

$$= \frac{7}{2} \times 10^{-3} \text{ sec}^{-1}$$

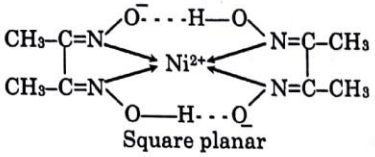
$$= \frac{7 \times 10^{-3} \times 60}{2} \text{ min}^{-1}$$

So, $T_{1/2} = \frac{\ell n 2}{7 \times 30 \times 10^{-3}}$ min

$$= \frac{693}{7 \times 30} = 3.3 \text{ min}$$

46.[C] L mol^{-1} s^{-1}

47.[C] The complex is



Square planar

48.[C] In the first complex ligand is O_2^{2-} which is oxidized into O_2^{1-}
Hence $O-O$ bond length decreases

49.[A] $2HSO_4^- \longrightarrow S_2O_8^{--} + 2H^+ + 2e^-$
So required rate = 1 mole/hr
= 2 mole of e$^-$/hr
$= \frac{2\times 96500\ C}{3600\ \text{sec}}$
$= \frac{2\times 965}{36}\text{A} \simeq 53.6\text{ A}$
So required current = $\frac{4}{3}\times 53.6$ A
= 71.4 A

50.[A] Anode $Zn \longrightarrow Zn^{2+} + 2e^-$
Cathode $2H^+ + 2e^- \longrightarrow H_2$
Cell $Zn + 2H^+ \rightleftharpoons H_2 + Zn^{2+}$
$E^0_{cell} = 0 - (-0.76) = 0.76$ V
$\therefore\ 0.701 = 0.76 - \frac{0.059}{2}\log\frac{0.01\times 1}{[H^+]^2}$
$\therefore\ [H^+] = 10^{-2}$ M
$\therefore$ NaOH required is 0.01 mole = 0.4 gms

51.[B] We want to prepare sol of AgI having positively charged particles, so a little excess of Ag^+ should be added to KI

52.[A] Refer notes

53.[A] Quinol is acting as an acid it is donating H^+ ions and also as a reducing agent due to $Ag^+ \rightarrow Ag$.

54.[B] Gauche form is more stable due to intramolecular H-bond

55.[B] HBr in presence of peroxide or perester give anti markovnikoff addition product.

56.[C] $Ph-Br \xrightarrow{Mg/Et_2O} Ph-MgBr \xrightarrow{CO_2} Ph-COOMgBr \xrightarrow{H_3O^\oplus} Ph-COOH$

57.[A] β-D Glucose is the most stable because in this all the large groups at equitorial positions

58.[B] Toluene in presence of halogen + lewis acid gives electrophilic substitution product.

59.[C] Factual (according to their functional groups present in the polymers)

60.[A] Boiling point ∝ molecular mass

BIOLOGY

61.[C] Both

62.[D] none

63.[B] $\frac{2101}{2101}$

64.[B] emulsify fats and solublize them

65.[C] Insects birds, reptile

66.[C] Reduction in all type of blood cells

67.[C] Oxytocin

68.[B] Conditioned reflex

69.[C] Hyposecretion of thyroid gland

70.[D] Tetanus

71.[D] Sex-linked

72.[D] Weismann

73.[C] Fore limbs of man and horse

74.[C] Study of fossil

75.[A] Pollination by birds

76.[A] XO

77.[C] Turner's syndrome

78.[B] linkage

79.[C] all colour blind

80.[A] tyrosinase

PART-II [Two Marks Questions]

MATHEMATICS

81.[A] Let $a = 2^{x_1}5^{y_1}$, $b = 2^{x_2}5^{y_2}$, $2^{x_3}5^{y_3}$
LCM $(a, b) = 2^2\,5^2$
LCM $(b, c) = 2^3\,5^2$
LCM $(c, a) = 2^3\,5^2$
Atleast two of y_1, y_2, y_3 must be 2
$\Rightarrow$ (2, 2, 0) (2, 2, 1) (2, 0, 2) (2, 1, 2) (0, 2, 2) (1, 2, 2) (2, 2, 2)
No. of ways of doing it = 7
$x_3 = 3$ as x_1, x_2 can not take the value 3.
Atleast one of x_1, x_2 must be 2
$\Rightarrow$ (0, 2) (1, 2) (2, 2) (2, 1) (2, 0)
Number of ways of doing it = 5
Hence total number of ways = $7 \times 5 = 35$

82.[C] Let minimum value is ℓ
$x^2 + 2xy + 3y^2 - 6x - 2y = \ell$ for some $x, y \in R$
$x^2 + x(2y - 6) + 3y^2 - 2y - \ell = 0$
$D \geq 0$
$4(y-3)^2 - 4\,.\,(3y^2 - 2y - \ell) \geq 0$
$\ell \geq 2y^2 + 4y - 9$
$\ell \geq 2(y+1)^2 - 11$
$\ell_{min} = -11$

83.[A] $p + q < r + s$ .....(1)
$q + r < s + t$ .....(2)
$r + s < t + p$ .....(3)
$s + t < p + q$ .....(4)
from (1) & (3) $p + q < r + s < t + p \Rightarrow q < t$
from (2) & (4) $q + r < s + t < p + q \Rightarrow r < p$
from (1) & (4) $s + t < p + q < r + s \Rightarrow t < r$
Thus $q < t < r < p$
From (1) $p + q < r + s$ & $r < p$
$\Rightarrow p + q + r < r + s + p \Rightarrow q < s$
From (4) $s + t < p + q$ & $q < t$
$\Rightarrow s + t + q < p + q + t \Rightarrow s < p$
Hence largest & smallest numbers are p & q respectively

84.[C] $(x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx) = 4$
$x \geq 1, y \geq 1, z \geq 1 \Rightarrow x + y + z \geq 3$
Possible values of $x + y + z = 4$
$x + y + z = 4$
Possible triplet (2, 1, 1) (1, 2, 1) (1, 1, 2)
By checking these triplet satisfy the above equation

85.[B] Case-I : 1 is a first place, 2 at any place, selecting 7 out of rest 8 numbers and arranging them in rest 7 places
1. ${}^8C_1 \times {}^8C_7\,.\,7! = 8.8!$

Case-II : 1 is not at first place
Job is done in two steps
Step 1 $\rightarrow$ selecting 2 places from rest 8 places and placing 1, 2.
No. of ways = ${}^8C_2\,.1$
Step 2 $\rightarrow$ arranging rest no.s it can be done by two cases
(i) including zero, i.e. selecting 6 out of 7 and arranging them
${}^7C_6\,.6.6! = 6.7!$
(ii) zero is not included no. of ways = 7!
Hence total no. of ways
$= 8.8! + {}^8C_2\,.(6.7! + 7!) = 260.7!$

86.[A] let $p\,(a\sec\theta, b\tan\theta)$
Equation of chord of contact $T = 0$
$$\frac{x.a\sec\theta}{a^2} - \frac{yb\tan\theta}{b^2} = 2$$
$$\frac{x\sec\theta}{a} - \frac{yb\tan\theta}{b} = 2 \quad \text{.....(1)}$$
Equation of asymptotes $y = \frac{b}{a}x$ .....(2)
$$y = -\frac{b}{a}x \quad \text{.....(3)}$$
Solving (1) and (2)
$$R\left(\frac{2a}{\sec\theta + \tan\theta}, \frac{-2b}{\sec\theta - \tan\theta}\right)$$
Solving (1) and (3)
$$S\left(\frac{2a}{\sec\theta + \tan\theta} + \frac{-2b}{\sec\theta + \tan\theta}\right)$$
$$\Delta_{ORS} = \frac{1}{2}\left(\frac{4ab}{\sec^2\theta - \tan^2\theta} + \frac{4ab}{\sec^2\theta - \tan^2\theta}\right)$$
$\Delta_{ORS} = 4ab$

87.[C] $\sin^{-1}\frac{ax}{c} = \sin^{-1}x - \sin^{-1}\frac{bx}{c}$

$\Rightarrow \frac{ax}{c} = x\sqrt{1-\frac{b^2x^2}{c^2}} - \sqrt{1-x^2}\,\frac{bx}{c}$

(i) $x = 0$

(ii) $a = \sqrt{c^2 - b^2x^2} - b\sqrt{1-x^2}$

$a + b\sqrt{1-x^2} = \sqrt{c^2 - b^2x^2}$

$\Rightarrow a^2 + b^2(1-x^2) + 2ab\sqrt{1-x^2}$
$= a^2 + b^2 - b^2x^2$

$\Rightarrow 1 - x^2 = 0 \qquad \Rightarrow x = \pm 1$

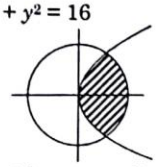
88.[D] $\tan\{x\}$ is a periodic function with period 1 and $\tan x = 1$ has one solution in $[0, 1)$
Hence solution of $\tan\{x\} = 1$ in $[-2\pi, 2\pi]$

are $x = n + \frac{\pi}{4}$

Where $n = \{-7, -6, -5, \ldots\ldots 4, 5\}$
total no. of solution = 13

89.[A] Region common to $y^2 < 4x$ and $x^2 + y^2 < 16$ is the shaded region in the figure consider the curves

$y^2 = 4x,\ x^2 + y^2 = 16$ .....(i)



the line $y = 0$ intersects the curves in (i) at $x = 0$ and $x = 4$ it gives 3 integral points
the line $y = 1$ intersects the curves in (i) at $x = \frac{1}{4}$ and $x = \sqrt{15}$ it gives 3 integral points
the line $y = 2$ intersects the curves in (i) at $x = 1$ and $x = \sqrt{12}$ it gives 2 integral points
the line $y = 3$ intersects the curves in (i) at $x = \frac{9}{4}$ and $x = \sqrt{7}$ it gives no integral points
Total number of integral points in the region is
$3 + 2(3 + 2) = 13$

90.[B] Total number of matrices = 3^9
Number of symmetric matrices = 3^6
Number of skew-symmetric matrices = 3^3
The zero matrix is both symmetric and skew symmetric and therefore the

required probability = $\frac{3^9 - 3^6 - 3^3 + 1}{3^9}$

PHYSICS

91.[D] Ball will lift when $qE \geq mg$
$(\rho Av)\ tE \geq mg$

$t \geq \frac{mg}{\rho AvE}$

$t \geq \frac{50 \times 10}{5 \times 10^{-12} \times \pi\left(\sqrt{\frac{2}{\pi}}\right)^2 \times 2 \times 10^6 \times 5 \times 10^5}$

$t \geq 25$ sec

92.[A] From conservation of momentum, if speed of sphere A is v, then speed of sphere B is $\frac{v}{2}$

From conservation of energy

$$\frac{1}{2}mv^2 + \frac{1}{2}(2m)\left(\frac{v}{2}\right)^2 = \frac{-kQ^2}{5R} + \frac{kQ^2}{2R}$$

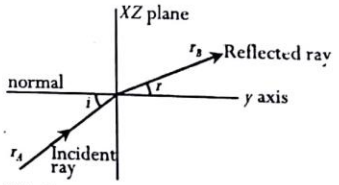
or $\frac{3}{4}mv^2 = \frac{3}{10}\frac{kQ^2}{R}$ or $v = \sqrt{\frac{2}{5}\frac{kQ^2}{mR}}$

93.[C] For $t = 0$ to $t = 4$: $\frac{dB}{dt}$ is negative

And for $t = 4$ to $t = 8$: $\frac{dB}{dt}$ is positive

$\therefore$ sign of current will change only once

94.[A]



We have

$\cos\theta = \frac{\vec{A}.\vec{B}}{ab}$

Similarly here

$\cos i = \frac{\vec{r}_A.\hat{j}}{|r_A|.|1|} = \frac{(a\hat{i} + b\hat{j}).\hat{j}}{\sqrt{a^2 + b^2}}$

$= \frac{b}{\sqrt{a^2 + b^2}}$

and $\cos r = \frac{\vec{r}_B.\hat{j}}{|r_B|.|1|} = \frac{(\alpha\hat{i} + \beta\hat{j}).\hat{j}}{\sqrt{\alpha^2 + \beta^2}}$

$= \frac{\beta}{\sqrt{\alpha^2 + \beta^2}}$

From shell's law

$\mu_1 \sin i = \mu_2 \sin r$

$\Rightarrow \mu_1\sqrt{1-\cos^2 i} = \mu_2\sqrt{1-\cos^2 r}$

$\Rightarrow \mu_1\sqrt{1-\frac{b^2}{b^2+a^2}} = \mu_2\sqrt{1-\frac{\beta^2}{\alpha^2+\beta^2}}$

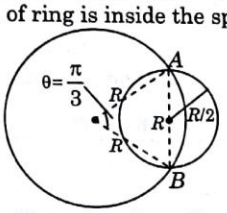
$\Rightarrow \mu_1\frac{a}{\sqrt{b^2+a^2}} = \mu_2\frac{\alpha}{\sqrt{\alpha^2+\beta^2}}$

Both $\vec{r}_A$ & $\vec{r}_B$ are unit vector so magnitudes of both vector is 1

i.e. $\sqrt{b^2+a^2} = \sqrt{\alpha^2+\beta^2} = 1$

So $\mu_1 a = \mu_2 \alpha$

95.[D] Flux will be maximum when maximum length of ring is inside the sphere



This will occur when the chord AB is maximum. Now maximum length of chord AB = diameter of sphere. In this case the arc of ring inside the sphere subtends an angle of $\frac{\pi}{3}$ at the centre of ring.

$\therefore$ charge on this arc $= \frac{R\pi}{3}.\lambda$

$\therefore \phi = \frac{\frac{R\pi}{3}\lambda}{\epsilon_0} = \frac{R\pi\lambda}{3\epsilon_0}$

96.[C] Here oscillating rod is an ac source because emf induced in it is ($\upsilon B\ell$); which varies sinusoidally because υ varies sinusoidally. Maximum current will flow through the circuit under resonance condition. Therefore time period of oscillation of rod is $T = 2\pi\sqrt{LC} = 2\text{sec}$

97.[B] 35.35 cm

98.[D] $N_x = \frac{N_0}{2}.e^{-\lambda_1 t} = 0.2\ N_0$

$N_y = \frac{N_0}{2}.e^{-\lambda_2 t} = 0.8\ N_0$

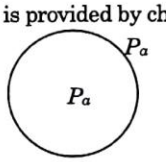
$e^{(\lambda_1-\lambda_2)} = 4 \Rightarrow t = 8\times10^9$ years

99.[A] $\frac{hc}{\lambda} = 5\ eV_0 + \phi$

$\frac{hc}{3\lambda} = eV_0 + \phi \Rightarrow \frac{2hc}{3\lambda} = 4eV_0$

$\Rightarrow \phi = \frac{hc}{6\lambda}$

100.[B] Inside pressure must be $\frac{4T}{r}$ greater than outside pressure in bubble. This excess pressure is provided by charge on bubble.



$\frac{4T}{r} = \frac{\sigma^2}{2\varepsilon_0}$

$\frac{4T}{r} = \frac{Q^2}{16\pi^2 r^4 \times 2\varepsilon_0}$ ..... $\left[\sigma = \frac{Q}{4\pi r^2}\right]$

$Q = 8\pi r\sqrt{2rT\varepsilon_0}$

CHEMISTRY

101.[A] $Q_C = \frac{\left(\frac{6}{2}\right)^2}{\left(\frac{2}{2}\right)\left(\frac{4}{2}\right)^3} = \frac{9}{8}$

$Q_C < K_c$ so reaction will proceed in forward direction.

102.[C] $x = 0.1 - 0.08 = 0.02$ M;

$k = \frac{x}{t} = \frac{0.02}{10} = 2\times10^{-3}$ M min^{-1}

$\therefore t_{12} = \frac{[A]_0}{2K} = \frac{0.1}{2\times2\times10^{-3}} = 25$ min

$t_{\text{completion}} = 2 \times t_{1/2} = 50$ min;

103.[B] P is most stable due to H-bonding in it's gauche conformations.

104.[A] $Fe(OH)_3$ is a positive sol. Hence, greater the charge on cation, more is the coagulation power.

105.[B] $\underset{sp^3}{\ddot{N}H_3} + H^+ \longrightarrow \underset{sp^3}{NH_4^+}$

$2\underset{sp^3}{NH_3} \rightleftharpoons \underset{sp^3}{NH_2^-} + \underset{sp^3}{NH_4^+}$

$\underset{sp^2}{H_3BO_3} + OH^- \longrightarrow \underset{sp^3}{[B(OH)_4]^-}$

$\underset{sp^3}{H_2O} + H^+ \rightleftharpoons \underset{sp^3}{H_3O^+}$

106.[A] Only for this reaction E° will come out to be positive, calculate using relation

$\Delta G^\circ = \Delta G_1^\circ + \Delta G_2^\circ$

and $\Delta G^\circ = -nFE^0_{cell}$

107.[D] (a) $[H^+] = y \times 10^{-x}$

$\Rightarrow pH = -\log[H^+]$

$\Rightarrow -\log[y \times 10^{-x}]$

$\Rightarrow -\log y - \log 10^{-x}$

$\Rightarrow x\log_{10}10 - \log y$

$\Rightarrow x - \log y$

(b) $[H^+] = \frac{1}{y} \times 10^{-x}$

$\Rightarrow pH = -\log\left[\frac{1}{y} \times 10^{-x}\right]$

$\Rightarrow x - \log\frac{1}{y}$

$\Rightarrow x + \log y$

(c) $[H^+][OH^-] = 10^{-14}$

$\Rightarrow -\log[H^+][OH^-] = -\log 10^{-14}$

$\Rightarrow -\log H^+ - \log OH^- = 14$

$pH = 14 + \log[OH^-]$

108.[D] For the given curve

(a) $a = E_0$

(b) $b = E_A$

(c) $\Delta H_A = b - d$ and $\Delta H_b = a - c$

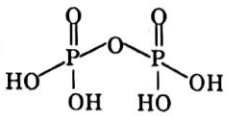
109.[D] NH_2Cl gives NH_3, NH_4NO_3 gives N_2O and $AgNO_3$ gives NO_2

(a) $NH_4Cl \xrightarrow{\Delta} NH_3 + HCl$

(b) $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

(c) $AgNO_3 \xrightarrow{\Delta} Ag + NO_2 + \frac{1}{2}O_2$

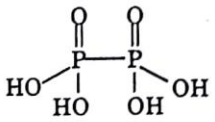
110.[B] (A)



$H_4P_2O_7$

Pyrophosphoric acid

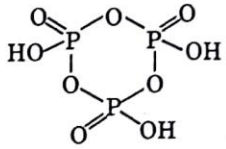
(B)



$H_4P_2O_6$

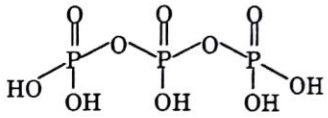
Hypophosphoric acid

(C)



Tricyclometaphosphoric acid

(D)



$H_5P_3O_{10}$

Tripolyphosphoric acid

BIOLOGY

111.[D] Requirement of special membrane proteins

112.[A] Diandric

113.[C] yes, only if the parent plant was a completely inbred line

114.[C] Mustard gas & nitrous acid are chemical mutagens

115.[B] More abundant secondary xylem

116.[B] Proconsul → Pliopithecus → Dryopithecus → Ramapithecus → Oreopithecus → Aurtralopithecus → Homoerectus → Neanderthal → Early homo sapiens → Cro-magnon → Modern man

117.[C] i-d, ii-c, iii-b, iv-a

118.[B] A-ii, B-i, C-iv, D-iii

119.[B] A-iii, B-iv, C-ii, D-i

120.[C] Hashish causes after thought perceptions and hallucinations